Appendix A Known Structures within CALFED ERP Geographic Scope

County	River name	Description	Latitude	Longitude
ALAMEDA	Alameda Creek	Dam	37.5945008	-121.9009022
	Alameda Creek	Diversion	37.497	-121.7798
	Alameda Creek	Dam	37.5114	-121.8250
	Alameda Creek	Apron	37.5869437	-121.9601558
	Alameda Creek	Road	37.598	-121.938
	Alameda Creek	Weir	37.5685500	-121.9877836
	Alameda Creek	Pipeline	37.576	-121.872
	Alameda Creek	Inflatable Rubber Dam	37.5730	-121.9705
	Alameda Creek	Inflatable Rubber Dam	37.5658	-121.9958
	Alameda Creek	Weir	37.559	-121.865
	Alameda Creek	Dam	37.5133	-121.8264
	Alameda Creek	Dam	37.5862	-121.9617
	Alameda Creek	Dam	37.569	-121.9869
	Arroyo Del Valle	Earth	37.615	-121.745
	Arroyo Mocho	Unknown	37.677	-121.910
	Arroyo Mocho	Drop Structure	37.68	-121.788
	Arroyo Mocho	Road	37.583	-121.622
	Calaveras Creek	Hydraulic Fill	37.492	-121.82
	San Antonio Creek	Earth	37.573	-121.848
	San Leandro Creek	Hydraulic Fill	37.73	-122.122
	San Leandro Creek	Earth	37.763	-122.095
	San Lorenzo Creek	Concrete		
	San Lorenzo Creek	Dam	37.6922	-122.0577
	San Lorenzo Creek	Dam	37.704	-122.0538
	Stonybrook Creek	Culvert	37.6099	-121.943
	Temescal Creek	Earth	37.848	-122.23
AMADOR	Dry Creek Tributary	Earth	38.355	-120.998
	Jackson Creek	Earth & Rock	38.303	-120.888
	Little Indian Creek Tributary	Earth	38.475	-120.882
	Mule Creek Tributary	Earth	38.368	-120.937
	Murphy Creek	Dam	38.2343	-121.0256
	Murphy Creek	Road	38.2287	-121.0287
	Pigeon Creek	Earth	38.533	-120.813
BUTTE	Big Chico Creek	Natural	39.7769	-121.7497
	Big Chico Creek	Diversion	39.762	-121.791
	Big Chico Creek	Natural	39.890	-121.694
	Big Chico Creek	Natural	39.784	-121.739
	Big Chico Creek	Irrigation Dam	39.887	-121.670
	Big Chico Creek	Weir	39.762	-121.792
	Big Chico Creek	Dam	39.735	-121.829

County	River name	Description	Latitude	Longitude
	Big Chico Creek	Weir	39.762	-121.791
	Butte Creek	Diversion	39.623	-121.773
	Butte Creek	Hydro diversion	39.982	-121.588
	Butte Creek	Gates	39.195	-121.935
	Butte Creek	Dam	39.867	-121.632
	Butte Creek	Culvert	39.290	-121.923
	Butte Creek	Dam	39.702	-121.775
	Butte Creek	Hydro diversion	39.915	-121.614
	Butte Creek	Dam	39.603	-121.784
	Butte Creek	Natural	39.857	-121.633
	Butte Creek	Dam	39.710	-121.749
	Butte Creek	Weir	39.332	-121.903
	Butte Creek	Weir	39.309	-121.916
	Feather River	Dam	39.521	-121.546
	Feather River	Hydro diversion	39.545	-121.493
	Feather River	Dam	39.529	-121.543
	Sanborn Slough	Weir	39.326	-121.881
	Sanborn Slough	Weir	39.336	-121.891
	Wadsworth Canal	Weir	39.154	-121.733
CALAVERAS	Dry Creek 2 Tributary	Dam	38.027	-120.69
	Stanislaus River	Pits	37.844	-120.643
	Stanislaus River	Pits	37.862	-120.632
	Stanislaus River	Pits	37.852	-120.637
	Calaveras River	Dam	38.148	-120.824
	Calaveras River	Road	38.0752	-120.8838
	Calaveras River Tributary	Earth	38.142	-120.883
	Carson Creek Tributary	Earth dam	38.035	-120.498
	Esperanza Creek	Earth dam	38.298	-120.45
	Little Johns Creek	Earth dam	37.908	-120.625
	Penney Creek	Earth & rock dam	37.983	-120.648
	Stanislaus River	Multiple arch	37.863	-120.628
	Stanislaus River	Earth & rock dam	37.948	-120.525
	Stanislaus River	Gravity	37.875	-120.603
COLUSA	Bear Creek Tributary	Earth	39.197	-122.418
	Butte Creek	Weir	39.234	-121.944
CONTRA COSTA	Bear Creek	Earth	37.913	-122.208
	Dry Creek	Earth	37.912	-121.733
	Grayson Creek	Earth	38.005	-122.070
	Lafayette Creek	Earth	37.885	-122.138
	Marsh Creek	Dam	49.627	-120.600
	Marsh Creek	Drop structure	37.89	-121.723
	Marsh Creek Tributary	Diversion	37.892	-121.725
	Old River Tributary	Earth	37.83	-121.547

County	River name	Description	Latitude	Longitude
	San Pablo Creek	Earth	37.943	-122.260
	Unnamed Stream	Earth	37.858	-121.670
	Wildcat Creek	Earth	37.897	-122.25
EL DORADO	Deer Creek	Earth	38.682	-120.99
	Deer Creek Tributary	Earth	38.672	-121.633
FRESNO	Fancher Creek	Dam	36.800	-119.525
	Fresno Slough	Earth dam	36.563	-120.167
	Hildreth Creek Tributary	Dam	37.062	-119.822
	Holland Creek Tributary	Dam	36.807	-119.44
	Kings River	Diversion	36.799	-119.394
	Kings River	Dam	36.9195	-119.0217
	Kings River	Diversion	36.762	-119.401
	Kings River	Diversion	36.452	-119.617
	Kings River	Levees	36.521	-120.059
	Kings River	Dam	36.401	-119.669
	Kings River	Dam	36.436	-119.673
	Kings River	Drop structure	36.468	-119.971
	Kings River	Gravity	36.832	-119.325
	Kings River Tributary	Weir	36.435	-119.67
	Kings River Tributary	Flashboard & buttress	36.46	-119.992
	Little Panoche Creek	Dam	36.8	-120.783
	Redbank Creek	Dam	36.81	-119.58
	San Joaquin River	Earth dam	36.868	-119.67
	San Joaquin River	Irrigation diversion	36.905	-119.779
	San Joaquin River	Road	36.911	-119.768
	San Joaquin River	Diversion	36.781	-120.371
	San Joaquin River	Road	36.943	-119.678
	San Joaquin River	Pits		
	San Joaquin River	Diversion	36.933	-119.739
	San Joaquin River	Diversion	36.786	-120.372
	San Joaquin River	Road	36.858	-119.811
	San Joaquin River	Road	36.944	-119.737
	San Joaquin River	Diversion	36.778	-120.369
	San Joaquin River	Diversion	36.786	-120.373
	San Joaquin River	Flashboard & buttress	36.788	-120.372
	San Joaquin River	Diversion	36.778	-120.369
	San Joaquin River	Diversion	36.984	-120.499
GLENN	Stony Creek	Diversion	39.798	-122.262
	Stony Creek	Dam	39.586	-122.531
	Stony Creek	Diversion	39.763	-122.155
KINGS	Kings River	Flashboard & buttress	36.388	-119.788
	Kings River	Flashboard & buttress	36.387	-119.877
	Kings River	Flashboard & buttress	36.388	-119.788

County	River name	Description	Latitude	Longitude
	Kings River	Flashboard & buttress	36.42	-119.667
	Kings River	Flashboard & buttress	36.418	-119.722
	Kings River	Flashboard & buttress	36.487	-119.535
LAKE	Cache Creek	Gravity	38.923	-122.565
MADERA	Chowchilla River	Earth & rock dam	37.217	-119.983
	Chowchilla River	Earth dam	37.152	-120.276
	Coarse Gold Creek	Dam	37.163	-119.783
	Fresno River	Earth dam	37.11	-119.883
	Fresno River	Dam	37.018	-119.995
	Hildreth Creek Tributary	Dam	37.062	-119.822
	Longhollow Creek	Dam	37.182	-119.768
	San Joaquin River	Earth dam	37.128	-120.188
	San Joaquin River	Diversion	36.774	-120.284
	San Joaquin River	Diversion	36.788	-120.354
	San Joaquin River	Road	36.843	-119.932
	San Joaquin River	Pits	36.867	-119.807
	San Joaquin River	Pits	36.866	-119.803
	San Joaquin River	Pits	36.863	-119.808
	San Joaquin River	Pits	36.861	-119.811
	San Joaquin River	Pits	36.860	-119.807
	San Joaquin River	Pits	36.855	-119.809
	San Joaquin River	Pits	36.856	-119.808
	San Joaquin River	Pits	36.857	-119.808
	San Joaquin River	Pits	36.853	-119.810
MADERA	San Joaquin River	Pits	36.851	-119.814
	San Joaquin River	Pits	36.851	-119.819
	San Joaquin River	Pits	36.854	-119.858
	San Joaquin River	Pits	36.850	-119.866
	San Joaquin River	Pits	36.851	-119.869
	San Joaquin River	Pits	36.851	-119.875
	San Joaquin River	Pits	36.858	-119.888
	San Joaquin River	Pits	36.852	-119.902
	San Joaquin River	Pits	36.847	-119.910
	San Joaquin River	Pits	36.846	-119.920
	San Joaquin River	Pits	36.848	-119.925
	San Joaquin River	Pits	36.841	-119.934
	San Joaquin River	Pits	36.836	-119.938
	San Joaquin River	Pits	36.835	-119.948
	San Joaquin River	Pits	36.836	-119.958
	San Joaquin River	Pits	36.835	-119.959
	San Joaquin River	Pits	36.834	-119.955

County	River name	Description	Latitude	Longitude
	San Joaquin River	Pits	36.834	-119.962
	San Joaquin River	Pits	36.836	-119.976
	San Joaquin River	Pits	36.838	-119.976
	San Joaquin River	Pits	36.858	-119.811
	San Joaquin River	Road	36.852	-11.8125
	San Joaquin River	Road	36.853	-119.814
	San Joaquin River	Canal	36.786	-120.373
	San Joaquin River	Dam	36.8	-120.4
	San Joaquin River	Road	36.833	-119.965
	San Joaquin River	Flood control dam	36.774	-120.284
MARIN	Novato Creek	Earth	38.112	-122.637
	Salmon Creek	Earth	38.16	-122.698
	San Antonio Creek Tributary	Earth	38.182	-122.685
MARIPOSA	Bear Creek	Earth dam	37.37	-120.228
	Horse Creek Tributary	Dam	37.357	-119.892
	Mariposa	Earth dam	37.291	-120.146
	Merced River	Earth & rock dam	37.522	-120.309
	Owens Creek	Earth dam	37.314	-120.185
MERCED	Bear Creek	Diversion	37.258	-120.792
	Bear Creek	Dam	37.312	-120.531
	Bear Creek	Diversion	37.225	-120.767
	Bear Creek	Diversion	37.225	-120.767
	Burns Creek	Earth dam	37.377	-120.275
	Canal Creek	Earth dam	37.404	-120.543
	Dry Creek	Earth dam	37.544	-120.358
	Dry Creek South Fork	Dam	37.543	-120.355
	Los Banos Creek	Dam	37	-120.93
	Merced River	Pits	37.467	-120.599
	Merced River	Pits	37.428	-120.676
	Merced River	Gravity	37.515	-120.37
	Merced River	Dam	37.513	-120.445
	Merced River	Pits	37.435	-120.651
	Merced River	Dam	37.496	-120.465
	Merced River	Dam	37.513	-120.445
	Merced River	Pits	37.427	-120.671
	Merced River	Pits	37.470	-120.542
	Merced River	Pits	37.444	-120.642
	Merced River	Pits	37.443	-120.636
	Merced River	Pits	37.461	-120.605
	Merced River	Pits	37.469	-120.596
	Merced River	Pits	37.469	-120.585
	Merced River	Pits	37.471	-120.585
	Merced River	Pits	37.470	-120.566

County	River name	Description	Latitude	Longitude
	Merced River	Dam	37.518	-120.436
	Merced River	Pits	37.439	-120.645
	Merced River	Gravity	37.522	-120.328
	Merced River	Pits	37.468	-120.507
	Merced River	Pits	37.452	-120.612
	Merced River	Road	37.471	-120.566
	Merced River	Road	37.470	-120.565
	Merced River	Pits	37.475	-120.496
	Merced River	Unknown	37.481	-120.483
	Merced River Tributary	Dam	37.372	-120.437
	Mustang Creek	Earth dam	37.503	-120.66
	Owens Creek	Dam	37.251	-120.479
	Owens Creek	Dam	37.263	-120.458
	San Joaquin River	Hydro diversion		
	San Joaquin River	Diversion	37.259	-120.763
	San Joaquin River	Diversion	37.204	-120.692
	San Joaquin River	Unknown	37.202	-120.756
	San Joaquin River	Diversion	37.113	-120.589
NAPA	Angwin Branch	Earth	38.587	-122.46
	Angwin Creek	Earth	38.588	-122.463
	Angwin Creek Tributary	Earth	38.597	-122.472
	Carneros Creek Tributary	Earth	38.297	-122.362
	Carneros Creek Tributary	Earth	38.258	-122.35
	Chiles Creek Tributary	Earth	38.558	-122.357
	Conn Creek	Earth	38.482	-122.372
	Conn Creek Tributary	Earth	38.518	-122.417
	Crystal Creek Tributary	Earth	38.535	-122.44
	Gordon Val Creek Tributary	Earth	38.337	-122.097
	Huichica Creek Tributary	Earth	38.269	-122.367
	Kimball Creek	Earth	38.622	-122.61
	Ledgewood Creek	Earth	38.32	-122.087
	Maxwell Creek	Earth	38.562	-122.378
	Moore Creek	Earth	38.582	-122.432
	Napa River Tributary	Earth	38.507	-122.49
	Napa River Tributary	Earth	38.392	-122.377
	Napa River Tributary	Gravity	38.32	-122.268
	Putah Creek	Dam	38.513	-122.103
	Rector Creek	Earth	38.442	-122.345
	Suisun Creek	Earth	38.358	-122.123
	York Creek	Dam	38.5133517	-122.5013891

County	River name	Description	Latitude	Longitude
NEVADA	Deer Creek	Variable radius	39.268	-120.952
	Deer Creek	Earth	39.273	-120.928
	Deer Creek Tributary	Earth & rock	39.235	-121.22
	Dry Creek	Earth	39.135	-121.133
PLACER	Bear Creek	Earth	38.762	-121.173
	Bear River Tributary	Earth	39.03	-121.335
	Bear River Tributary	Earth	39.002	-121.145
	Dry Creek	Pipeline	38.734	-121.274
	Dry Creek	Earth	38.962	-121.072
	Dry Creek	Debris dam	38.734	-121.391
	Dry Creek, South Fork	Earth & rock	38.922	-121.043
	Dry Creek, South Fork	Earth	38.963	-121.023
	Dry Creek, South Fork	Earth	38.973	-121.012
	Dry Creek Tributary	Earth	38.973	-121.038
	Miners Ravine	Road	38.7537	-121.1799
	Miners Ravine	Road	38.7509	-121.1709
	Miners Ravine	Road	38.7889	-121.1446
	Miners Ravine	Bridge	38.7850	-121.1799
	Miners Ravine	Road	38.7532513	-121.1708778
	Miners Ravine	Dam	38.764	-121.157
	Miners Ravine	Road	38.7563	-121.2243
	Miners Ravine	Dam	38.7584	-121.2065
	Miners Ravine	Dam	38.7584	-121.2065
	Miners Ravine	Road	38.7531	-121.1719
	Miners Ravine	Dam	38.7641	-121.1592
	Miners Ravine	Dam	38.7838	-121.1495
	Miners Ravine	Dam	38.7883	-121.1492
	Miners Ravine	Dam	38.7982	-121.1354
	Miners Ravine	Dam	38.8119	-121.1252
	Miners Ravine	Dam	38.8171	-121.1254
	Miners Ravine	Dam	38.8175	-121.1257
	Miners Ravine	Dam	38.8236	-121.126
	Miners Ravine	Road	38.8252	-121.1259
	Secret Ravine	Pipeline	38.7594	-121.2552
SACRAMENTO	American River	Gravity	38.637	-121.223
	American River Tributary	Earth	38.645	-121.153
	Cosumnes River	Natural	38.521	-120.962
	Cosumnes River	Road	38.3084636	-121.3765480
	Cosumnes River	Diversion	38.4051032	-121.2835950
	Cosumnes River	Diversion	38.4511369	-121.2098876
	Cosumnes River	Gravity	38.497	-121.065
	Cosumnes River Tributary	Earth	38.502	-121.067
	Cosumnes River Tributary	Earth	38.51	-121.072

County	River name	Description	Latitude	Longitude
	Cosumnes River Tributary	Earth	38.5	-121.107
	Cosumnes River	Dam	38.452	-121.209
	Cosumnes River	Dam	38371	-121.323
	Dry Creek	Dam	38.683	-121.442
	Dry Creek Tributary	Earth	38.305	-121.057
	Laguna Creek Tributary	Earth	38.302	-121.332
	Sacramento River	Weir	38.6056	-121.5561
	Unnamed	Earth	38.442	-121.478
SAN JOAQUIN	Calaveras River	Diversion	38.045	-121.077
	Calaveras River	Diversion	38.008	-121.249
	Calaveras River	Dam	38.065	-120.985
	Calaveras River	Diversion	38.052	-121.011
	Calaveras River	Dam	38.020	-121.213
	Calaveras River	Dam	38.046	-121.197
	Calaveras River	Dam	38.072	-120.923
	Calaveras River	Dam	38.061	-121.161
	Calaveras River	Dam	38.069	-121.123
	Calaveras River	Dam	38.068	-120.974
	Calaveras River	Dam	38.005	-121.268
	Calaveras River	Dam	38.053	-121.013
	Calaveras River	Dam	38.049	-121.191
	Calaveras River Tributary	Earth	38.057	-121.03
	Calaveras River Tributary	Earth	38.102	-121.03
	Mokelumne River	Irrigation dam	38.157	-121.297
	Mokelumne River	Diversion		
	Mokelumne River Tributary	Earth	38.217	-121.045
	Mormon Slough	Dam	37.961	-121.159
	Mormon Slough	Dam	38.040	-121.046
	Mormon Slough	Dam	38.03	-121.047
	Mormon Slough	Dam	38.020	-121.061
	Mormon Slough	Dam	37.965	-121.138
	Mormon Slough	Road	38.040	-121.029
	Mormon Slough	Dam	37.960	-121.199
	Mormon Slough	Road	37.979	-121.09
	Mormon Slough	Dam	38.008	-121.07
	Mormon Slough	Dam	37.993	-121.082
	Mormon Slough	Dam	37.993	-121.09
	Mormon Slough	Dam	37.978	-121.111
	Mormon Slough	Dam	37.965	-121.136
	Mormon Slough	Dam	37.963	-121.155
	Mormon Slough	Dam	37.961	-121.169
	Mormon Slough	Dam	37.98	-121.246
	Mormon Slough	Dam	37.968	-121.120

County	River name	Description	Latitude	Longitude
	Mormon Slough	Road	38.006	-121.082
	Mormon Slough Tributary	Earth	38.043	-120.99
	Mosher Creek	Dam	38.049	-121.072
	Mosher Creek	Road	38.052	-121.087
	Mosher Creek	Dam	38.074	-121.166
	Mosher Creek	Dam	38.073	-121.202
	Mosher Creek	Dam	38.072	-121.198
	Mosher Creek	Road	38.055	-121.223
	Mosher Creek	Road	38.056	-121.219
	Mosher Creek	Dam	38.058	-121.214
	Mosher Creek	Dam	38.069	-121.203
	Mosher Creek	Dam	38.071	-121.203
	Mosher Creek	Dam	38.054	-121.243
	New Channel Of Potter Creek	Dam	37.994	-121.070
	New Channel Of Potter Creek	Dam	38.014	-121.054
	New Channel Of Potter Creek	Road	38.012	-121.060
	Potter Creek	Dam	37.9947	-121.0650
	Potter Creek	Dam	37.9664	-121.0856
	Potter Creek	Road	37.9861	-121.0728
	Potter Creek	Road	38.0358	-121.0317
	Potter Creek	Dam	38.016	-121.042
	Potter Creek	Dam	38.0098	-121.0664
	Potter Creek	Dam	37.9647	-121.1028
	Potter Creek	Dam	37.9608	-121.1033
	Potter Creek	Dam	37.9608	-121.1117
	Potter Creek	Dam	37.9572	-121.1475
	Potter Creek	Dam	37.9572	-121.1403
	Potter Creek	Dam	38.0275	-121.0419
	San Joaquin River Tributary	Earth dam	37.933	-121.342
SAN MATEO	Bear Gulch	Weir	37.4155	-122.2420
	Bear Gulch	Pipeline	37.4216	-122.2465
	Bear Gulch	Weir	37.4169	-122.2435
	Bear Gulch	Dam	37.414	-122.2417
	Bear Gulch	Dam	37.412	-122.240
	Bear Gulch	Culvert	37.4176	-122.2664
	Bear Gulch	Weir	37.4236	-122.2400
	Bear Gulch	Culvert	27.4256	-122.2617
	Bear Gulch	Dam	37.4159	-122.2684
	Belmont Creek	Earth	37.508	-122.307
	Laurel Creek	Earth	37.527	-122.322
	McGarvy Gulch	Culvert	37.4440	-122.2938
	Peters Creek	Earth	37.307	-122.173
	San Francisquito Creek	Dam	37.4073978	-122.2369044

County	River name	Description	Latitude	Longitude
	Sanchez Creek	Earth	37.565	-122.373
	Squealer Gulch	Road	37.4368	-122.2828
	West Union Creek	Weir	37.4336	-122.2776
	West Union Creek	Weir	37.4372	-122.2827
	West Union Creek	Fence	37.4276	-122.2692
	West Union Creek	Dam	37.4314	-122.2752
	West Union Creek	Culvert	37.4253	-122.2660
SANTA CLARA	Alamitos Creek Tributary	Earth	37.198	-121.84
	Alamitos Creek	Earth	37.165	-121.828
	Arroyo De Los Coches Tributary	Earth	37.455	-121.86
	Beardsley Creek	Earth	37.22	-122.052
	Coyote Creek	Flashboard & buttress	37.24	-121.763
	Coyote Creek	Earth	37.167	-121.628
	Guadalupe Creek	Earth	37.198	-121.878
	Los Gatos Creek	Earth	37.247	-121.963
	Los Gatos Creek	Earth	37.202	-121.988
	Los Gatos Creek	Earth	37.132	-121.93
	Los Trancos Creek	Dam	37.3761	-122.1963
	Los Trancos Creek	Weir		
	Los Trancos Creek	Concrete weir		
	Los Trancos Creek	Concrete curb		
	Los Trancos Creek	Diversion dam		
	Los Trancos Creek	Culvert	37.361	-122.201
	Los Trancos Creek	Flashboard dam		
	Los Trancos Creek	Culvert	37.375	-122.199
	Los Gatos Creek	Gravity	37.122	-121.907
	San Francisquito Creek	Concrete weirs		
	San Francisquito Creek	Apron		
	San Francisquito Creek	Diversion dam		
	San Francisquito Creek	Road crossing		
	San Francisquito Creek	Dam		
	San Francisquito Creek	Drop structure	37.4543	-122.1596
	San Francisquito Creek	Dam	37.4534	-122.1303
	San Francisquito Creek	Road	37.4238	-122.1898359
	San Francisquito Creek	Drop structure	37.4541	-122.1599
	San Francisquito Creek	Dam	37.4192	-122.1875
	Stevens Creek	Earth	37.298	-122.077
SHASTA	Clear Creek	Dam	40.5067	-122.3883
	Clear Creek	Diversion	40.493	-122.470
	Clear Creek	Dam	40.598	-122.537
	Cow Creek	Hydro diversion		
	Cow Creek	Diversion		
	Little Cow Creek	Irrigation diversion	40.641	-122.212

County	River name	Description	Latitude	Longitude
	Little Cow Creek	Hydro diversion	40.773	-121.831
	North Fork Battle Creek	Hydro diversion	40.452	-121.861
	Old Cow Creek	Hydro diversion	40.687	-121.807
	Old Cow Creek	Dam	40.616	-122.004
	Old Cow Creek	Hydro diversion	40.664	-121.896
	Sacramento River	Flashboard & buttress	40.593	-122.393
	Sacramento River	Gravity	40.612	-122.445
	Sacramento River	Gravity	40.612	-122.443
	South Cow Creek	Irrigation diversion	40.567	-122.027
	South Cow Creek	Hydro diversion	40.593	-121.981
	South Cow Creek	Dam	40.588	-121.944
SOLANO	Carquinez Straight Tributary	Earth	38.077	-122.225
	Napa River Tributary	Earth	38.14	-122.238
	Pennsylvania Cr	Earth	38.26	-122.063
	Putah Creek	Culvert	38.5167529	-121.6376414
	Putah Creek	Dam	38.494	-122.004
	Putah Creek	Dam	38.5157714	-121.6107916
	Putah Creek	Dam	38.5216491	-121.9638524
	Suisun Bay Tributary	Earth	38.102	-122.125
SOLANO	Sacramento River	Tainter gates		
	Suisun Creek Tributary	Earth	38.298	-122.143
	Sulphur Springs Creek	Earth	38.097	-122.15
	Ulatis Creek	Dam	38.3289	-121.8126
	Ulatis Creek	Flashboard & buttress	38.335	-121.815
	Unnamed	Earth	38.153	-122.225
SONOMA	Carriger Creek Tributary	Earth	38.323	-122.563
	Hudeman Slough Tributary	Earth	38.232	-122.357
	North Creek	Earth	38.297	-122.577
	Petaluma Creek Tributary	Earth	38.158	-122.493
	Petaluma River Tributary	Earth	38.237	-122.532
	Sonoma Creek	Earth	38.355	-122.512
	Tolay Creek Tributary	Earth	38.214	-122.507
STANISLAUS	Dry Creek 2 Tributary	Dam	37.732	-120.545
	Lesnini Creek	Earth dam	37.818	-120.763
	San Joaquin River	Fish screen	37.349	-120.974
	Stanislaus River	Pits	37.753	-121.014
	Stanislaus River	Pits	37.764	-120.913
	Stanislaus River	Pits	37.769	-120.895
	Stanislaus River	Pits	37.769	-120.897
	Stanislaus River	Pits	37.771	-120.892
	Stanislaus River	Pits	37.788	-120.741
	Stanislaus River	Pits	37.814	-120.704
	Stanislaus River	Pits	37.809	-120.686

County	River name	Description	Latitude	Longitude
	Stanislaus River	Pits	37.811	-120.741
	Stanislaus River	Pits	37.819	-120.663
	Stanislaus River	Pits	37.802	-120.666
	Stanislaus River	Pits	37.822	-120.656
	Stanislaus River	Pits	37.771	-120.884
	Stanislaus River	Pits	37.770	-120.879
	Stanislaus River	Pits	37.771	-120.874
	Stanislaus River	Pits	37.771	-120.869
	Stanislaus River	Pits	37.772	-120.867
	Stanislaus River	Pits	37.808	-120.675
	Stanislaus River	Bridge	37.783	-120.750
STANISLAUS	Stanislaus River	Pits	37.813	-120.700
	Tuolumne River	Bridge	37.645	-120.495
	Tuolumne River	Pits	37.646	-120.494
	Tuolumne River	Pits	37.641	-120.664
	Tuolumne River	Dam	37.627	-120.986
	Tuolumne River	Pits	37.618	-120.847
	Tuolumne River	Pits	37.620	-120.843
	Tuolumne River	Bridge	37.618	-120.844
	Tuolumne River	Pits	37.644	-120.676
	Tuolumne River	Gravity	37.672	-120.443
	Tuolumne River	Bridge	37.633	-120.783
	Tuolumne River	Bridge	37.667	-120.470
	Tuolumne River	Bridge	37.666	-120.461
	Tuolumne River	Bridge	37.626	-120.992
	Tuolumne River	Pits	37.627	-120.526
	Tuolumne River	Pits	37.630	-120.552
	Tuolumne River	Pits	37.635	-120.594
	Tuolumne River	Pits	37.638	-120.727
	Tuolumne River	Pits	37.626	-120.780
	Tuolumne River	Pits	37.615	-120.798
	Tuolumne River	Pits	37.619	-120.824
	Tuolumne River	Pits	37.620	-120.843
	Tuolumne River	Pits	37.616	-120.856
	Tuolumne River Tributary	Earth dam	37.64	-120.477
	Tuolumne River Tributary	Dam	37.657	-120.45
	Tuolumne River Tributary	Hydraulic fill	37.612	-120.593
SUTTER	Butte Creek	Weir	39.234	-121.937
	Butte Creek	Weir	39.259	-121.940
	Butte Creek	Dam	39.359	-121.894
	Butte Creek	Weir	39.025	-121.819
	Cherokee Canal	Weir	39.289	-121.906
	Cherokee Canal	Weir	39.289	-121.905

County	River name	Description	Latitude	Longitude
	Cherokee Canal	Weir	39.289	-121.906
	Sutter Bypass/East Canal	Weir	38.896	-121.617
	Sutter Bypass/East Canal	Weir	39.103	-121.758
	Sutter Bypass/East Canal	Weir	38.915	-121.623
	Sutter Bypass/West Canal	Diversion	39.146	-121.841
	Sutter Bypass/West Canal	Weir	39.07	-121.758
	Sutter Bypass/West Canal	Weir	39.035	-121.743
	Sutter Bypass/West Canal	Weir	39.035	-121.743
	Sutter Bypass/West Canal	Weir	39.136	-121.831
TEHAMA	Antelope Creek	Diversion	40.187	-122.134
	Antelope Creek	Diversion	40.187	-122.134
	Antelope Creek	Diversion	40.187	-122.134
	Battle Creek	Weir	40.398	-122.144
	Deer Creek	Diversion	40.011	-121.953
	Deer Creek	Diversion	39.969	-122.016
	Deer Creek	Natural	40.168	-121.580
	Deer Creek	Dam	39.963	-122.033
	Deer Creek	Natural	40.202	-121.512
	Elder Creek	Unknown	40.044	-122.217
	Elder Creek	Unknown	40.017	-122.382
	Mill Creek	Diversion	40.056	-122.040
	Mill Creek	Diversion	40.055	-122.031
	Mill Creek	Diversion	40.053	-122.077
	North Fork Battle Creek	Hydro diversion	40.424	-121.918
	North Fork Battle Creek	Hydro diversion	40.420	-121.960
	Paynes Creek	Diversion	40.264	-122.186
	Sacramento River	Dam	40.153	-122.201
	South Fork Battle Creek	Natural	40.357	-121.727
	South Fork Battle Creek	Hydro diversion	40.402	-121.967
TEHAMA	South Fork Battle Creek	Hydro diversion	40.395	-121.882
	South Fork Battle Creek	Diversion	40.400	-121.921
	South Fork Battle Creek	Diversion	40.385	-121.819
	South Fork Battle Creek	Hydro diversion	40.369	-121.797
	Stony Creek	Earth	39.818	-122.337
	Stony Creek	Hydro diversion	39.808	-122.330
	Thomes Creek	Pits, stranding	39.977	-122.203
	Thomes Creek	Diversion	39.957	-122.327
	Thomes Creek	Diversion	39.890	-122.517
TUOLUMNE	Dry Creek Trib 1	Dam	37.75	-120.537
	Dry Creek Trib 2	Dam	37.762	-120.6
	Tuolumne River	Earth & rock dam	37.701	-120.420
YOLO	Cache Creek	Earth	38.683	-121.673
	Sacramento River	Flood control dam	38.7811665	-121.6163725

County	River name	Description	Latitude	Longitude
YUBA	Bear River	Earth & rock	39.05	-121.315
	Bear River	Gravity	39.042	-121.332
	Yuba River	Dam	39.209	-121.444
	Yuba River	Variable radius	39.239	-121.269

Appendix B Applicable Laws and Examples of Fish Passage Programs at Other Agencies

Applicable Laws and Regulations

California Fish and Game Commission and Department of Fish and Game

The Fish and Game Commission and the Department of Fish and Game make up the fish and wildlife resource management branch of State government. DFG has broad jurisdiction over man-made or natural fish barriers, fishways, dam modifications, fish water bypasses, artificial barriers, and fish entrainment situations.

In the early 1900s, the California Legislature made it unlawful to impede fish passage (Fish and Game Code Sections 5901 and 5931) and made unlawful the accumulation of mining debris or logjams that impede fish passage (Fish and Game Code Section 5948). Later the Legislature required fish screens on diversions (Fish and Game Code Section 5980).

DFG has mandated authority to influence the management of watersheds through inspecting the design of dams for fishery protection, issuing Streambed Alteration Agreements, and commenting on Timber Harvest Plans. DFG is mandated "from time to time" to examine all dams in the state and to order, upon a finding by the Fish and Game Commission, dam owners to construct a fishway if there is not free passage for fish over or around the dam (Fish and Game Code Section 5930-1). Fish and Game Code Section 5937 requires dam owners to allow sufficient water to pass through the dam to keep in good condition any fisheries downstream of the dam.

The Fish and Game Commission receives applications for new dams filed with the Department of Water Resources (DWR) and can order the construction of a fishway, if it is necessary and practical. If not, the commission can order the owner to establish a fish hatchery (Fish and Game Code Sections 5933 and 5938). Of broad effect, Fish and Game Code Sections 1600–1616 charge DFG with regulating any project altering the bed, bank, or channel of a river, stream, or lake if that project may substantially impact fish and wildlife resources.

In issuing a Streambed Alteration Agreement, DFG is required to propose modifications to the project to protect any fish and wildlife resources on the site that may be substantially adversely affected. The Salmon, Steelhead Trout and Anadromous Fisheries Program Act of 1988 required DFG to establish a comprehensive program to increase the natural production of salmon and steelhead trout, as opposed to production via hatcheries. The act established as State policy that this should be accomplished primarily through improvement in stream habitat. In addition, habitats shall not be diminished without offsetting the impacts (Fish and Game Code Sections 6900–6957). DFG reviewed dam removals in the Klamath River Drainage in the early 1950s. Subsequently, in the early 1950s, 23 dams were removed, opening up at least 210 miles of spawning stream (Handley and Coots 1953).

State and Federal Species Protection Legislation

In 1970 California enacted the Endangered Species Act. Three years later, the federal Endangered Species Act of 1973 became law. Both laws protect animal species by designating them as either threatened or endangered. The laws require State and federal agencies to develop and implement plans to protect and recover populations of the designated species. The US Fish and Wildlife Service (USFWS) and NOAA's National Marine Fisheries Service (NMFS) enforce the federal version of the law, and DFG is responsible for enforcement of the State law.

In October 1986 the federal Electric Consumer Protection Act was enacted. It required the Federal Energy Regulatory Commission (FERC) to consider the value of fish and wildlife in its hydroelectric power program. It also required that recommendations of federal and state fish and wildlife agencies be considered when new power plants are built. In 1992 the federal Central Valley Project Improvement Act (CVPIA) became law. It required that the Central Valley Project consider fish and wildlife protection and restoration as important a priority as irrigation, domestic water uses, and power generation.

Other Programs

California Resources Agency

In November 1999 the California Resources Agency (Resources Agency) convened a group of State, local, and federal agencies, fisheries conservation groups, researchers, restoration contractors, and others to discuss ways to restore and recover anadromous salmonid populations by improving fish passage at road crossings with culverts. This effort was part of the Resources Agency’s effort to implement the California Coastal Salmon and Watersheds Program, which included an objective to coordinate fish passage activities. Through coordinating resources and authorities and creating the Fish Passage Forum, a comprehensive program was achieved and formalized in a Memorandum of Understanding that was to be signed by all cooperators by the end of 2002. As trustee for fisheries resources, DFG serves as the principal coordinator for the Fish Passage Forum.

For more information, contact:
Cathy Bleier, Resources Agency,
(916) 653-6598, e-mail:
cathy@resources.ca.gov

or Julie Brown, DFG,
(916) 327-8843, e-mail:
jbrown@dfg.ca.gov

The Fish Passage Forum participants have worked together to develop short-term solutions for several high priority fish passage projects. They have also developed a strategic plan to facilitate and coordinate fish passage inventory and assessment, data sharing and database development needs, fish passage design, fish passage project implementation, training, and public education and outreach.

Five-counties Program

The five North Coast counties of Humboldt, Mendocino, Trinity, Siskiyou, and Del Norte began a coordinated effort to inventory, prioritize, and resolve fish passage at road crossings, such as bridges, roads, and culverts. The program is overseen by NOAA's NMFS and is going into its fourth year.

For more information, contact Miles Croom, (707) 575-6068, e-mail: Miles.Croom@noaa.gov

California Department of Fish and Game

DFG carries out many fish passage and fish protection projects through a variety of programs. DFG's fish passage programs are implemented by the regional offices. Two fish screen shops in Region 1, one shop in Region 2, and one shop in Region 4 build, install, and maintain screens for diversions and some fish ladders. Central Valley region offices (Regions 1, 2 and 4) each have an Anadromous Fish Restoration Program coordinator supported by the USFWS AFRP which coordinates with local, federal, and other State agencies on fish passage and fish protection and habitat restoration projects in the region. In addition, DFG provides funds from grant and bond programs for projects that benefit anadromous salmonids, including fish passage projects. Proposals are accepted annually, and advisory committees recommend projects for funding.

For more information, contact Paul Raquel, (916) 227-2330, e-mail: praquel@dfg.ca.gov

DFG established a statewide fish passage coordinator in the Native Anadromous Fish and Watershed Branch, assisting in the coordination of fish passage programs in other agencies and nongovernmental organizations, as well as acting as lead person coordinating the Fish Passage Forum for statewide activities to restore anadromous fish passage.

DFG's Statewide Fish Screen and Fish Passage Program, part of the Inland Fisheries Division's Salmon, Steelhead Trout and Anadromous Fisheries Restoration and Enhancement Program, has identified and is performing the following activities: (1) inventory of water diversion and fish passage problems; (2) evaluation and prioritization of fish screening and fish passage problems; (3) implementation or coordination fish protection activities; (4) evaluation of existing and proposed fish protective installations; and (5) review of fish screening and fish passage literature.

Fish Passage Criteria. DFG has developed draft guidelines that address fish passage at road crossings and culverts. The guidelines set criteria for water velocities, water depths and high and low passage flows for adult and juvenile salmonids. The draft guidelines are available from DFG upon request. The Fish Passage Improvement Program (FPIP) uses these and NMFS criteria to guide evaluations of road crossings and culverts.

California Coastal Conservancy

The State Coastal Conservancy provides grants and technical assistance to nonprofits, local governments, Resource Conservation Districts, and other organizations for watershed planning, assessment, implementation projects, and monitoring. Many such efforts address fish migration barriers. The conservancy is participating with State and federal agencies and nonprofit organizations in evaluating the removal of Matilija Dam, evaluating alternatives for fish passage at San Clemente Dam on the Carmel River,

For more information, contact: Michael Bowen, (510) 286-0720, e-mail: mbowen@scc.ca.gov contributing funding for fish ladders on Robles Dam on the Ventura River, and providing funding for fish passage improvement projects in Humboldt, Del Norte, and Mendocino counties. Through an interagency agreement, FPIP is assisting the California Coastal Conservancy with its coastal barrier inventory. The conservancy, with $750,000 provided by State legislation, is developing a comprehensive assessment of barriers to fish passage in many coastal watersheds. The assessment will compile and standardize existing data into an Internet-accessible GIS database. The assessment program will be augmented by an ongoing conservancy-funded assessment of road and stream crossings in Marin County and proposed assessments of barriers in streams of the Santa Monica Mountains and the Sisquoc watershed. In compiling this assessment, the conservancy will draw from many other barrier assessment efforts statewide. A final report of the program was due in February 2003.

California Department of Transportation

In 2000 Caltrans began implementing a Statewide Passage Barrier Assessment and Correction Program within each of its districts to assess state highway culverts and stream crossings for fish passage impediments. The program will enhance Caltrans' overall rate of completing inventories and facilitate prioritization of funding for sites needing correction.

For more information on Caltrans efforts to restore fish passage, contact:

Deborah McKee,
(916) 653-8566, e-mail:
Deborah_McKee@dot.ca.gov

The statewide assessment of highway culverts started along the Northern California coast (District 1) and is now progressing to the northeast and Central Coast areas of the state (Districts 2, 4, 5). Humboldt State University, as part of an interagency agreement with Caltrans, is performing the field assessment and analysis of state highway routes in Northern California.

Caltrans signed an interagency agreement with DWR' FPIP to assist with inventory and analysis of culverts along the remainder of the state's highways. Caltrans is pursuing restoration partnerships with other agencies and local watershed groups as one method of augmenting funding for implementing corrective actions at road crossings to improve fish passage conditions.

In 2001 Caltrans and the National Park Service received an Environmental Enhancement and Mitigation grant for fish passage remediation on Solstice Creek. The Caltrans program is also working on development of a fish passage engineering manual for Caltrans engineers and biologists to use as a guide for road and culvert construction in streams.

NOAA's National Marine Fisheries Service (NMFS)

FERC relicensing. NMFS has authority under Sections 18 and 10(j) of the Federal Power Act to protect fish at hydroelectric facilities. Specifically, under Section 10(j) NMFS recommends to a FERC licensee conditions for fish protection, mitigation, and enhancement. Section 18 expressly authorizes the Department of Commerce to issue mandatory fishway prescriptions, stating that FERC must require construction, maintenance, and operations by a licensee at its own expense of such fishways as may be prescribed by the Secretary. Over the next 10 or more years, NMFS proposes to participate in numerous FERC relicensing actions. Forty-two project licenses in California are either undergoing relicensing or will expire between 2000 and 2010. The FERC anticipates that up to 85 percent of project applicants will opt to use the Alternative Licensing Process, a new collaborative approach to relicensing intended to improve efficiency. NMFS anticipates greatly increased demands on staff as a result.

For more information contact Steve Edmondson, (707) 575-6080, e-mail: steve.edmondson@noaa.gov

Fish Passage Criteria. NMFS has developed criteria for water velocities, water depths and high and low passage flows for adult and juvenile salmonids. The guidelines address fish passage at road crossings and culverts. The FPIP uses these and DFG criteria to guide evaluations of road crossings and culverts.

The NMFS guidelines are available at http://swr.nmfs.noaa.gov/

US Bureau of Reclamation

CVPIA Anadromous Fish Restoration and Screening Programs. The US Bureau of Reclamation is involved with fish passage improvements in the Central Valley through two CVPIA-funded programs (co-managed by USBR and USFWS)—the Anadromous Fish Screen Program and the AFRP. The AFSP directs the Department of the Interior to help the state avoid losses of juvenile anadromous fish resulting from unscreened or inadequately screened diversions. The program provides a mechanism and a major source of funds to minimize and avoid loss of juvenile anadromous fish at diversions. Since 1996 the AFSP has helped fund more than 25 projects, 17 of which have been completed. Through the program, diversions of totaling almost 4,000 cfs will be screened. Roughly 70 percent of all diversions over 250 cfs were to be screened within the Sacramento and San Joaquin River systems, the Delta, and Suisun Marsh by end of 2002 fiscal year.

For more information, contact Bill O'Leary, USBR AFSP, (916) 978-5207, e-mail: **woleary@mp.usbr.gov**

US Fish and Wildlife Service

The AFRP implements a program through a variety of actions that has the goal of at least doubling natural production of anadromous fish in California's Central Valley streams. Since 1995 the AFRP has helped implement more than 70 projects to restore natural production of anadromous fish. USBR and USFWS jointly manage and fund projects such as the removal of Saeltzer Dam on Clear Creek (see Chapter 4) and improvements at Red Bluff Diversion Dam on the Sacramento River (see Chapter 3). In addition, USBR responded to a request from Ventura County for assistance with investigations at Matilija Dam on Matilija Creek. USBR was already performing fish passage and flood control projects at two other dams in the

Anadromous Fish Restoration Program in Central Valley: http://delta.dfg.ca.gov/afrp

For more information, contact: John Icanberry, USFWS AFRP, (209) 946-6400, e-mail: **john_icanberry@fws.gov** same watershed, so it was deemed appropriate for the agency to undertake sediment and feasibility studies at Matilija Dam as well (see Chapter 3).

Literature Cited

Handley J, Coots M. 1953. The removal of abandoned dams in the upper Klamath River drainage, California. California Department of Fish and Game. 39(3): p 365-374.

Appendix C Structure Removal Examples and Challenges

Red Bluff Diversion Dam Fish Passage Improvement – Tehama County

Red Bluff Diversion Dam is on the Sacramento River immediately downstream of Red Bluff. When the dam's gates are lowered into the Sacramento River, the water behind the 41-foot-high and 752-foot-wide dam is raised, creating Lake Red Bluff and allowing gravity diversion into the Tehama-Colusa and Corning canals for delivery to 17 irrigation districts. With the gates in place, the dam presents an upstream and downstream obstacle to migrating fish. Fish ladders are inefficient at certain flows. Additionally, the tailrace and lake created by the dam provide habitat for species that prey on juvenile salmon, reducing their survival rates. Fish passage at the dam is crucial because a substantial number of Chinook salmon in the Sacramento River naturally spawn in the reach upstream of the dam.

Photo C-1 Sacramento River—Red Bluff Diversion Dam/USBR photo

In 1995 a large research pumping plant was installed. The pumps take fish and water at the same time but screen the fish out after pumping. Testing of the pumps concluded in 2001, and results are being reviewed to determine if such technology could be used in place of the diversion dam or elsewhere. Capital and research costs were about $25 million.

In addition, the Tehama-Colusa Canal Authority (TCCA)—with Central Valley Project Improvement Act (CVPIA) and California Proposition 204 funds—and the US Bureau of Reclamation (USBR) are jointly funding the Fish Passage Improvement Project at the dam. The project is seeking alternative diversions to reduce the impacts of the dam on upstream and downstream migration of juvenile and adult anadromous fish, while improving the reliability of agricultural water supply to the Tehama-Colusa and Corning Canal systems. Three alternatives include (1) dam improvements and construction of new fish ladders, (2) fish screens and pumps, or (3) year-round "gates-out" with water diverted by pumps and screened intakes. Recreation at the lake is important to Red Bluff and the surrounding community, so alternatives that affect the lake must be carefully weighed.

The project is in Phase II, Preliminary Design and Environmental Documentation. A record of decision is expected by April 2003. Once the ROD is completed, future phases will include Phase III, Final Design and Permit Coordination; Phase IV, Construction; and Phase V, Monitoring, which will be conducted for 7 to 10 years thereafter.

Cooperating agencies, organizations, and others include TCCA, USBR, city of Red Bluff, Tehama County, Red Bluff Chamber of Commerce, Farm Bureau, fishing and environmental interests, educational groups, US Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), California Department of Fish and Game (DFG), and the California Department of Water Resources (DWR).

For more information, go to Web site or contact staff listed below:
http://www.tccafishpassage.org/

Mike Urkov, project planner, CH2M Hill.
(530) 229-3238; e-mail: murkov@ch2m.com

Harry Rectenwald, DFG,
530) 225-2368; e-mail: hrectenw.@dfg.ca.gov

Art Bullock, TCCA.
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Max Stodolski, USBR.
(530) 529-3890. e-mail: mstodolski@mp.usbr.gov

Diversion Dams, Butte Creek – Butte County

Numerous restoration projects on Butte Creek are completed or are under way. The creek is one of four Sacramento River tributaries that support populations of Central Valley spring-run Chinook salmon. The Western Canal Water District's (WCWD) Butte Creek Fish Passage Improvement Project involved five dams: Point Four Dam, Western Canal Main Dam, Western Canal East Channel Dam, McGowan Dam, and McPherrin Dam. The dams ranged from 6- to 12-feet high and 10- to 100-feet wide.

Project objectives were to eliminate 12 unscreened diversions that impacted juvenile salmonids, to reconfigure water delivery facilities to make them fish-safe, to restore spawning and rearing habitat for threatened spring-run Chinook salmon, and to increase water supply reliability for agriculture and in wildlife refuges. The project also faced the challenges of working within the allowable construction windows to avoid or minimize impacts to salmonids, avoiding interruption of water deliveries during construction, determining how to dewater the construction sites, and overcoming logistical difficulties associated with the distance between construction sites. The project covered 60 square miles.

Completed in the early 1900s, the Western Canal Main and Western Canal East Channel Dams allowed WCWD's Main Canal to cross Butte Creek. Western Canal Main Dam also diverted Butte Creek water for agriculture. Both dams had fish ladders, but they were antiquated. Western Canal Main, Western Canal East Channel, McGowan, and McPherrin dams were removed in 1998 at a cost of $9.5 million. Point Four Dam was removed in 1993 at a cost of $365,000. Funding sources included the Anadromous Fish Restoration Program (Central Valley Project Improvement Act), the Ecosystem Restoration Program (CALFED Bay-Delta Program Category III), Four Pumps Mitigation Fund, WCWD, and California Urban Water Agencies. The project removed barriers and modified water diversion and conveyance facilities to restore 25 miles of Butte Creek to unimpeded flow for the first time since the 1920s. This was done while maintaining full water deliveries.

Additional Butte Creek fish passage improvement projects built or replaced defunct fish ladders at other dams, including:

- Parrott-Phelan Fish Screen and Fish Ladder Project (1994)
- Durham Mutual Fish Ladder and Fish Screen Project (1996)
- Rancho Esquon Partners Fish Ladder and Fish Screen Project (1996)
- Gorrill Ranch Fish Ladder and Fish Screen Project (1996).

Benefits of the restoration work have already been seen. The number of adult spring-run spawners increased from 14 in 1987 to 20,000 in 1998.

Centerville and Butte Creek head dams (PG&E hydropower dams upstream of the Butte Creek restoration project) have been considered for removal or modification, but there are unresolved issues about modification of downstream natural barriers and concerns about restrictions on land-use

Photo C-2 Butte Creek—Western Canal Dam before removal

Photo C-3 Butte Creek—Western Canal Dam before during removal

For more information, contact:

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Kevin Dossey, DWR
(530) 529-7362; e-mail:
dossey@water.ca.gov

For more information about Butte Sink projects, contact:

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robcap@inreach.com

activities should Endangered Species Act-listed anadromous fish gain access to the upper watershed.

Butte Creek Restoration

Restoration of Butte Creek has begun with several restoration plans with varying objectives. Included are:

- Upper Sacramento River Fisheries and Riparian Habitat Management Plan (SB 1086), January 1989, with the stated goal "... to protect, restore, and enhance the fish and riparian habitat and associated wildlife of the upper Sacramento River" and tributaries.
- Central Valley Salmon and Steelhead Restoration and Enhancement Plan (SB 2261), April 1990, with the stated goals to "(1) restore all depleted salmon and steelhead habitat to a condition capable of sustaining population goals; (2) at least double the natural salmon production by the year 2000; (3) develop an annual steelhead run in the Sacramento River system of 100,000 fish; (4) ensure proper mitigation and compensation of existing projects that have resulted in resource loss or which are continuing to cause resource damage; (5) ensure that future projects either avoid adverse impacts to salmon and steelhead and their habitats or provide compensation where impacts cannot be avoided; and (6) enhance the quality of fishing opportunities for inland sport, ocean sport, and commercial users and maintain populations at levels capable of supporting sustained year-round angling opportunities."
- Restoring Central Valley Streams: A Plan for Action, November 1993, with the stated goal "... to restore and protect California's aquatic ecosystems that support fish and wildlife and to protect threatened and endangered species."
- Revised Draft Restoration Plan for the Anadromous Fish Restoration Program (CVPIA AFRP), May 1997, with the stated goal to "... implement a program which makes all reasonable efforts to ensure that, by the year 2002, natural production of anadromous fish in Central Valley rivers and streams will be sustainable, on a long-term basis, at levels not less than twice the average levels attained during the period of 1967-1991."
- CALFED Bay-Delta Program Ecosystem Restoration Program, July 2000, with the stated goal to "... restore ecosystem health and improve water management for beneficial uses of the Bay-Delta system."

Each of the following actions, listed generally in order of implementation, has been completed or is in progress in the Butte Creek watershed and has been implemented under the general goals and objectives of the above restoration plans.

Parrott-Phelan Diversion

1) Name: Parrott-Phelan Fish Screen and Fish Ladder Project.
2) Total Project Budget: $891,591 (Screen: DFG Prop. 70, $64,500; M&T Chico/Llano Seco Ranches $64,500) (Ladder: DFG, Wildlife Conservation Board, CVPIA and Four Pumps $756,591)
3) Total Spent to Date: $891,591
4) Stakeholder Groups/Agencies: M&T Chico Ranch, Llano Seco Ranch, USFWS, DFG.

5) Project Start Date: 1994
6) Project Goals and Objectives: Provide adequate passage for juvenile and adult anadromous fish.
7) Current Status: The fish ladder and screen are being operated and maintained by M&T Chico Ranch. Also, each of the structures is being used by resource agencies for technical analysis of structures and biological analyses of life history patterns of anadromous fish. The information generated has and is being used in the development and implementation of structures in other watersheds and to better define life history patterns of anadromous fish throughout their entire migratory range.
8) Future Actions: Land acquisition and riparian restoration are being implemented on lands adjacent to the project owned by both the M&T Chico Ranch and DFG.

Parrott-Phelan Diversion

1) Name: M&T Pumps Water Exchange
2) Total Project Budget: $4.6 million for pump relocation and screening on Sacramento River. Water exchange was not valued but was M&T Chico/Llano Seco Ranch's contribution to project cost.
3) Total Spent to Date: same as above
4) Stakeholder Groups/Agencies: M&T Chico and Llano Seco Ranches, DFG, USFWS, USBR, State Water Resources Control Board (SWRCB), Butte County Superior Court (adjudication), DWR.
5) Project Start Date: 1996.
6) Project Goals and Objectives: Provide adequate flows in Butte Creek for anadromous fish.
7) Current Status: Water exchange agreement with USBR is being completed and will eventually result in a SWRCB permanent designation for instream use. Water exchange involves respective ranches leaving 40 cfs in Butte Creek (primarily west branch of Feather River water) from October to June, in exchange for the right to divert equal volume from Sacramento River at M&T Pumps.
8) Future Actions: Completion of water right agreements with USBR, SWRCB, Butte County Superior Court (adjudication). Potential additional water acquisitions at the Parrott-Phelan diversion site to provide ultimate minimum base flow.

Western Canal Diversions

1) Name: Western Canal Siphon Project
2) Total Project Budget: $9.7 million. (Initial planning: WCWD $150,000; DFG Tracy Mitigation $150,000) (Implementation: WCWD, $3.133 million; CVPIA, $3.133 million; Cat. III Met., $3.133 million)
3) Total Spent to Date: $9.7 million
4) Stakeholder Groups/Agencies: WCWD, Gorrill Ranch, McGowan Ranch, McPherrin Ranch, USBR, DFG, USFWS, DWR.
5) Project Start Date: 1992
6) Project Goals and Objectives: Provide adequate fish passage at McPherrin, McGowan, Western Canal (2 dams) by removing respective dams from Butte Creek.
7) Current Status: Siphon installation and dam removals were completed during 1998. Butte Creek flows legally diverted at the sites where the

dams were removed have either been dedicated for instream use or moved to the Gorrill Diversion site. The WCWD provided alternate sources of water to all diverters previously utilizing the four structures.

8) Future Actions: None

Western Canal Diversion Water Rights

1) Name: Western Canal Project Water Rights Acquisition
2) Total Project Budget: Included in Western Canal Siphon and Gorrill Diversion Fish Ladder and Fish Screen Projects.
3) Total Spent to Date: Same
4) Stakeholder Groups/Agencies: WCWD, Gorrill Ranch, Alma Ryan, Jim McAlister, DFG, Butte County Superior Court (adjudication), DWR.
5) Project Start Date: 1992 (Part of overall Western Canal Siphon Project)
6) Project Goals and Objectives: Provide base instream flows of 10 cfs July through September downstream of the Gorrill Diversion site.
7) Current Status: Currently implemented and within the responsibility of the DWR Butte Creek Watermaster.
8) Future Actions: None.

Point Four Diversion

1) Name: Point Four Dam Removal Project.
2) Total Project Budget: $365,000 (WCWD $235,000; DFG Prop. 70, $130,000)
3) Total Spent to Date: $365,000
4) Stakeholder Groups/Agencies: Point Four Ranch, WCWD, DFG, DWR.
5) Project Start Date: 1991
6) Project Goals and Objectives: Provide adequate fish passage at Point Four Dam.
7) Current Status: Dam was removed in 1993 and an alternate source of water provided to the diverter via the WCWD.
8) Future Actions: Possible relocation of original Butte Creek water right for the benefit of fish and wildlife.

Durham Mutual Diversion

1) Name: Durham Mutual Fish Ladder and Fish Screen Project.
2) Total Project Budget: $935,441. (Initial Planning and design: DFG Tracy Mitigation $66,000) (Implementation: CVPIA, $464,720; CALFED Cat. III., $316,500; Four Pumps, $88,221)
3) Total Spent to Date: $935,441.
4) Stakeholder Groups/Agencies: Durham Mutual Water Company, DFG, DWR, TNC, DU.
5) Project Start Date: 1996
6) Project Goals and Objectives: Provide adequate fish passage at Durham Mutual Diversion Dam.
7) Current Status: The fish ladder and screen, which were completed in 1998, are operated and maintained by the Durham Mutual Water Company and are awaiting certification by the Anadromous Fish Screen Program (AFSP) technical team.
8) Future Actions: None.

Durham Mutual Dam Water Rights

1) Name: Durham Mutual Water Rights Acquisition Project.
2) Total Project Budget: Unknown
3) Total Spent to Date: Unknown
4) Stakeholder Groups/Agencies: Resource Renewal Institute (RRI), Butte County Superior Court (adjudication), SWRCB, Clarence Entler, Mary Roth, Bee Compton, DWR Butte Creek Watermaster.
5) Project Start Date: 1997
6) Project Goals and Objectives: Provide adequate flows in Butte Creek for anadromous fish
7) Current Status: Water rights to first priority Butte Creek flows (5 cfs April-September, 3 cfs October, 1.5 cfs November-March) were acquired by RRI for instream use. RRI is attempting to sell rights to USBR under CVPIA water acquisition program. RRI has filed under the Butte Creek Adjudication for dedication of acquired flows for instream use, and may file with SWRCB for similar dedication.
8) Future Actions: Potential acquisition of additional water rights at this site.

Adams Diversion

1) Name: Rancho Esquon Partners Fish Ladder and Fish Screen Project.
2) Total Project Budget: $1,108,460. (Initial Planning and design: DFG Tracy Mitigation $66,000) (Implementation: CVPIA $520,897; Cat. III Met. $520,897).
3) Total Spent to Date: $1,108,460.
4) Stakeholder Groups/Agencies: Rancho Esquon Partners, DFG, DWR, DU.
5) Project Start Date: 1996
6) Project Goals and Objectives: Provide adequate fish passage at Adams Diversion.
7) Current Status: Project was completed during 1998, with subsequent modifications to the low-flow fish ladder completed in 1999. Technical analysis of performance has been completed and is pending AFSP final certification. Fish ladder and fish screen are being operated and maintained by Rancho Esquon Partners.
8) Future Actions: DFG will closely monitor low-flow fish ladder for potential future modifications.

Gorrill Diversion

1) Name: Gorrill Ranch Fish Ladder and Fish Screen Project.
2) Total Project Budget: $1,618,563. (Initial Planning and design: DFG Tracy Mitigation $66,000) (Implementation: CVPIA $755,949; Cat. III Met/Prop. 204 $705,947).
3) Total Spent to Date: $1,618,563.
4) Stakeholder Groups/Agencies: Gorrill Ranch, DFG, DWR, DU, WCWD.
5) Project Start Date: 1996.
6) Project Goals and Objectives: Provide adequate fish passage at Gorrill Diversion and consolidate WCWD's remaining Butte Creek water rights.
7) Current Status: The project was completed during 1998 and has been certified by AFSP technical team. Fish screen and fish ladders are being operated and maintained by Gorrill Ranch.

8) Future Actions: Potential need for flow monitoring station immediately downstream of structure to manage instream flow acquisitions.

Sanborn Slough Bifurcation

1) Name: Bifurcation Sanborn Slough Water Control Structure Project.
2) Total Project Budget: $1.07 million. (Initial Planning and design: USFWS AFRP $70,000) (Implementation: USFWS Sacramento Refuge $1 million).
3) Total Spent to Date: $1.07 million
4) Stakeholder Groups/Agencies: CWA, DU, RD1004, Eric Foracre, Butte Sink Waterfowl Association, USFWS, DWR, DFG.
5) Project Start Date: 1998.
6) Project Goals and Objectives: Provide adequate fish passage and water control at Sanborn Slough Butte Sink bifurcation.
7) Current Status: Standalone subproject was completed as per total spent of $1.07 million. Management agreement is being developed with primary management responsibility assigned to RD1004, in conjunction with Eric Foracre, and the Butte Sink Waterfowl Association.
8) Future Actions: Initial project funding was insufficient to complete as per final design. Additional funding ($1 million) is currently being sought to complete additional phase of project.

MCAMIS Property Land Acquisition

1) Name: Butte Creek Ecological Preserve Honey Run Project.
2) Total Project Budget: $546,067. (CALFED Cat. III $186,128; NFWF $132,439; USFWS AFRP $125,000; WCB $102,500)
3) Total Spent to Date: $546,067
4) Stakeholder Groups/Agencies: CSUC Research Foundation, John McAmis, DFG, USFWS, BCWC.
5) Project Start Date: 1997
6) Project Goals and Objectives: Protect riparian corridor and aquatic habitat valuable to the restoration and survival of anadromous fish.
7) Current Status: The 90-acre McAmis property was acquired in 1998 and is contiguous with the DFG-owned Butte Creek Ecological Preserve Canyon and Virgin Valley Units which extend downstream to Highway 99. The California State University, Chico Research Foundation has completed a memorandum of understanding with DFG to assume management responsibility for entire Butte Creek Ecological Preserve and will use the McAmis (Honey Run Unit) for educational purposes in conjunction with CSUC.
8) Future Actions: Additional funding is being sought to initiate the first two years of management activities, after which it is anticipated that endowments funded by local donors and alumni will suffice.

Keeney Property Land Acquisition

1) Name: Butte Creek Preserve, Keeney Ranch
2) Total Project Budget: $735,000 (USFWS AFRP)
3) Total Spent to Date: $735,000
4) Stakeholder Groups/Agencies: The Center For Natural Lands Management, Butte County Fish and Game Commission, USFWS AFRP, CSUC Research Foundation, Keeney Ranch.
5) Project Start Date: 1997
6) Project Goals and Objectives: Protect riparian zone for the benefit of anadromous fish and other wildlife.
7) Current Status: The 56-acre Keeney property was acquired during 1997. The property is owned and managed by The Center for Natural Lands Management in partnership with the CSUC Foundation.
8) Future Actions: Completion of the management plan and riparian restoration is awaiting a permit from the State Reclamation Board. In conjunction with the Butte County Fish and Game Commission, approximately 15 acres will sell as a mitigation bank.

The Question of Structure Removal or Retention

About one-quarter of the 76,000 dams listed in the US Army Corps of Engineers National Inventory of Dams (NID) were constructed during the 1960s; many structures are now a half-century old. By the year 2020, the Association of State Dam Safety Officials estimates, 80 percent of all dams will reach their design life (ASDSO 2001). The downstream hazard of dams, in the event of failure, is considered significant or high for over 30 percent of the dams in the NID database. Consequently, many dams are or will soon be in need of safety rehabilitation.

The costs for dam rehabilitation can sometimes exceed the economic return of a dam. With 75 to 90 percent of dams in private or local government ownership, rehabilitation and continued operation is sometimes financially infeasible.

More than 2,200 dams in the United States are for hydroelectric generation and the Federal Energy Regulatory Commission issues operating licenses for more than 1,000 of these dams (FERC 2002). California, New York, Wisconsin and Maine collectively have more than 36 percent of the hydroelectric dams requiring FERC licenses. By the year 2010, more than a quarter of all FERC-licensed dams will need to be reissued a FERC license. Dam decommissioning is sometimes considered as an alternative during the relicensing process.

American Rivers has documented the removal of almost 500 structures, though the actual total is likely to be many more (Heinz 2002). The nation has many small dams that are abandoned or obsolete and whose owners may wish to consider removal as a viable option. Almost all dams removed were small and privately owned. Reasons for dam removal included economic or structural obsolescence, safety, legal or financial liability, dam site restoration, ecosystem and watershed restoration, riparian and aquatic species habitat restoration, unregulated flow recreation, and water quality or quantity.

Decision-making approaches about dam retention or removal include (1) establishing goals, objectives, and basis for the decision, (2) identifying major issues of concern, (3) assessing potential physical, biological, and economic and social indicators and outcomes, and (4) making decisions with a framework that encompasses costs and benefits, gains and losses, public support and concerns, and private and public interests. Data collection and assessment of outcomes such as likely future conditions are key components to each of these steps. This approach could be applied to any structure that obstructs fish migration (Heinz 2002; Trout Unlimited 2001).

Key Considerations

Four key areas for consideration in any dam removal or retention project: physical environment, biological changes, economic aspects, and social aspects (Heinz 2002).

Physical Environment

Dam removal can restore some but not all of the physical characteristics of the river that existed before the dam were built, but that the most important positive outcome of dam removal is the reconnection of river reaches so that they can operate as an integrated system again. The extent of biological changes can depend on such things as the size of the dam (storage capacity), quantity and quality of sediment in the reservoir, and stability of the downstream river reach (Heinz 2002).

Biological Changes

Dam removal may increase abundance and diversity of aquatic insects, fish and other populations; may destroy wetlands that existed in the reservoir but result in new wetlands downstream; or result in the replacement of one aquatic community with another by changing the environment from a lentic to lotic system. This may, therefore, create a partly natural and partly artificial population structure depending on species and resulting environmental conditions. The most significant biological benefit of removing a small structure is the increased accessibility of upstream habitat and spawning areas for migratory and anadromous fishes (Heinz 2002).

Economic Aspects

Traditional benefit-cost analysis (avoided costs of dam operation and external costs versus lost beneficial effects of dam operation) does not necessarily apply to dam removals because of the challenge of assigning monetary value for environmental losses or gains. While positives and negatives can be arrayed for various stakeholders, many environmental outcomes are uncertain or difficult to establish in monetary terms and adequately incorporate (Heinz 2002; Trout Unlimited 2001). Methods to quantify environmental benefits and costs have been under evaluation and development by the US Army Corps of Engineers in a recent study, Multi-Objective Approaches to Floodplain Management on a Watershed Basis.

More information on these economic evaluation methods and the study is available at http://www.ecosystemvaluation.org/ and at http://www.cop.noaa.gov/

Social Aspects

Finally, the social context of dam removal decisions is often as important as the environmental and economic contexts. Social outcomes of dam removal include aesthetics of the dam site, changed recreational opportunities, or loss of a historically significant structure or water body. Other issues may include property values, tribal rights, water quality, flood control, and maintenance of storage capability.

Dam removal decisions require careful planning and review. A removal project needs to be scientifically based taking into consideration specific economic and social contexts in planning process that are systematic, open and inclusive of the people in the affected communities.

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Three Photographs of Red Bluff Diversion Dam Fish Passage Improvement—Tehama County

Photo C-1 Sacramento River—Red Bluff Diversion Dam

USBR photo

Photo C-2 Butte Creek—Western Canal Dam before removal

Photo C-3 Butte Creek—Western Canal Dam during removal

Appendix D Evolutionarily Significant Units, Critical Habitat, and Essential Fish Habitat

NOAA's National Marine Fisheries Service (NMFS) administers the Endangered Species Act for marine species and anadromous fish. The act requires NMFS to use the best scientific and commercial data available about species and populations and their habitats to designate threatened or endangered species under the ESA and to identify the habitat necessary for their survival. NMFS has grouped steelhead and Chinook salmon populations into evolutionarily significant units (ESUs) based on two criteria: the population must be reproductively isolated, and it must represent an important component in the evolutionary legacy of the species. Habitat for endangered or threatened anadromous fish is designated as critical habitat under the ESA and as essential fish habitat (EFH) under the Magnuson-Stevens Fishery Conservation and Management Act. EFH has been designated for Chinook salmon, but not for steelhead.

Evolutionarily Significant Units

Steelhead along the West Coast are classified into 15 ESUs from Southern California to Canada and east to the Upper Columbia River drainage in Idaho. In California, five ESUs are listed: Northern California (threatened), Central California Coast (threatened), Central Valley (threatened), South-Central California Coast (threatened), and Southern California (endangered).

Likewise, Chinook salmon along the West Coast form 17 ESUs from Southern California to Canada and east to the Upper Columbia River drainage. In California, the Central Valley spring-run is listed as threatened, and the Central Valley winter-run is listed as endangered. One other California ESU, the Central Valley fall-run and late-fall run of Chinooks, is designated as a candidate species.

Critical Habitat

The ESA requires NMFS to designate critical habitat when a species is listed as endangered or threatened. Critical habitat is a specific area occupied by a listed species that has the physical or biological features essential to conservation of the species, and it may require special management or protection. Essential features include spawning sites, juvenile rearing areas and migration corridors, adult migration corridors, food resources, water quality and quantity, and riparian vegetation. NMFS has designated critical habitat for Central California Coast, South-Central California Coast, Southern California, and Central Valley steelhead, and for Central Valley spring-run and Sacramento River winter-run Chinook salmon. In general, “critical habitat is designated to include all river reaches accessible to listed salmon or steelhead within the range of the ESUs listed … ” (Federal Register 2000).

NMFS considers natural barriers and specific dams within the historical range of each ESU to be the upstream limit of a critical habitat designation. Critical habitat for the Central Valley spring-run is based on U.S. Geological Survey (USGS) hydrologic unit codes specified in the Final Rule (Federal

Register 2000), and critical habitat for Sacramento River winter-run Chinook salmon is based on the Final Rule (Federal Register 1993). Critical habitat for Central Valley and Central California Coast steelhead is based on USGS hydrologic unit codes specified in the Final Rule (Federal Register 2000).

Essential Fish Habitat

The Sustainable Fisheries Act of 1996 (Public Law 104-267) requires fishery management plans for threatened or endangered species to describe and identify EFH. In the Central Valley, only Chinook salmon are covered by this requirement. The act defines EFH as “those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity (NMFS 2000).” The act requires federal agencies to consult with NMFS whenever something they do might adversely affect EFH. Private entities are not required to consult with NMFS unless their activity is funded, permitted, or authorized by a federal agency and the project may adversely affect EFH. States are not required to consult with NMFS; however, NMFS is required to develop EFH conservation recommendations for any state agency activities that would impact EFH. Although the concept of EFH is similar to critical habitat of the ESA, measures recommended by NMFS or a regional fisheries management council to protect EFH are advisory, not prescriptive.

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Appendix E Bay Area and Delta Watersheds outside the FPIP Geographic Scope

Introduction

See Appendix G for bibliographic information on literature cited in this appendix

As discussed in Chapter 1, the Ecosystem Restoration Program (ERP) within the CALFED Bay-Delta Program is charged with water and ecosystem health in the Bay-Delta and its greater watershed. This includes, among other things, the enhancement and recovery of anadromous salmonid populations in the Bay Area, Delta, and the Sacramento and San Joaquin River watersheds. The Fish Passage Improvement Program (FPIP) supports ERP goals but has a more narrow geographic scope because FPIP's focus is only on waterways for which CALFED has identified fish passage goals. The Bay Area and Delta have their share of migratory barriers. However, CALFED has not identified fish passage goals for the Bay Area and Delta waterways. Consequently, they do not fall under the FPIP geographic scope at this time. Because of their importance and potential for enhancing ERP goals, we added a limited discussion of Bay Area and Delta waterways that provided habitat in the past or currently support native salmonid populations (Figure E-1). Not all waterways in the greater Bay-Delta are being presented in this version of Bulletin 250. Because of the need to focus FPIP resources on waterways with ERP fish passage goals, some important streams that support salmonid populations have been left out including Coyote, Wildcat, and Stevens creeks and the Guadalupe River.

Figure 3-1 2003 Fish Passage Improvement Program priority waterways and known structures of the Bay Area and Delta

Readers should understand that bulletins of the Department of Water Resources (DWR) are works in progress and are updated periodically. If and when the FPIP geographic scope is expanded, the following waterway discussions will be updated and presented. We wish to emphasize that the streams presented in this appendix do not represent an exhaustive list.

Bay Area and Delta Existing Habitat Conditions and Status of Fish Populations in Bay Area Streams

Alameda Creek – Alameda and Santa Clara Counties

Potential Impediments to Anadromous Fish Migration

There are eight dams, three weirs, a road crossing, and a gas pipeline crossing identified in Alameda Creek. In Alameda Creek, the BART Weir and an inflatable dam block fish passage at River Mile (RM) 9.7. On Upper Alameda Creek, the San Francisco Public Utilities Commission (SFPUC) operates a large water diversion structure—the Upper Alameda Creek Diversion. This structure blocks upstream passage and reduces streamflows downstream.

General Description

The Alameda Creek watershed is the largest drainage in the south bay of the San Francisco Bay Area. It flows from the Diablo Range west through Sunol Valley and Niles Canyon into southeastern San Francisco Bay just north of the Highway 92 bridge. It drains about 700 square miles (Aceituno and others date unknown). Alameda County Water District, the SFPUC, and Zone 7 of the Alameda County Flood Control and Water Conservation District (ACFC & WCD) use Alameda Creek and its tributaries for water supply and transport. The lower 11 miles of the creek have been channelized for flood control (Gunther and others 2000). In addition to Alameda Creek, two large and several small tributaries are described below.

Fish Populations

Alameda Creek is historically home to runs of coho and Chinook salmon, as well as Central California Coastal steelhead (Alameda Creek Alliance 23 Aug 2000). The Alameda Creek Alliance has letters and photographs documenting coho and Chinook salmon and steelhead in the Alameda Creek watershed going back to the early 1900s (Jeff Miller 2004 Jul pers comm.). Chinook salmon remains were excavated from Native American shell mounds (dated from A.D. 1 to A.D. 600) along Alameda Creek in Union City (Schulz 1986).

Today, only steelhead and Chinook salmon ascend the creek. They have recently been observed as far as 8 miles upstream from San Francisco Bay. In July 1995, the California Department of Fish and Game (DFG) did a stream inventory from Calaveras Dam to the Sunol Water Treatment Plant (SWTP). The report identified rainbow trout (DFG 1996a). Fifteen rainbows were caught just upstream of Calaveras Creek during a 1987 DFG fish survey (DFG 1988). Aceituno and others (date unknown) documented in DFG internal reports that rainbow trout were found in Alameda Creek in 1927, 1955, and 1957. NOAA's National Marine Fisheries Services (NMFS) has proposed to list the native resident rainbow trout (*Oncorhynchus mykiss*) in Alameda Creek, its tributaries, and populations in and above Calaveras and San Antonio reservoirs as a threatened species (69FR 33102). Recent

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genetic data strongly suggest that these native resident populations are part of the threatened Central California Coast steelhead evolutionarily significant unit.

In 1999 three steelhead were captured at the BART Weir. The Alameda Creek Alliance has videotape and film of them. In recent years, a few Chinook salmon were seen in the flood control channel downstream of the BART Weir. Salmon were also found in archaeological sites in the lower floodplain of Alameda Creek, but it is unknown if those fish were native or if they were transported to the sites (Gunther and others 2000). Run sizes for the salmon and steelhead runs in Alameda Creek are unknown.

Water Quality

Alameda Creek is perennial in its upper reaches but is periodically dry in Sunol Valley. Many of the creek's tributaries may be cut off from the main stem in the summer due to lack of flow. There are three major reservoirs in the Alameda Creek watershed, and water supply practices have greatly altered the natural flow in both the main stem and its tributaries. The creek is used as a conduit for water by three Bay Area water supply agencies; water from Hetch Hetchy and the South Bay Aqueduct also augment its flows.

The Niles Canyon area of the creek does has high summer temperature, "frequently exceeding 22 °C and occasionally reaching 26 to 28 °C in the upper part of the reach" (Gunther and others 2000). DFG conducted a stream inventory in Alameda Creek from the Calaveras Road Bridge to the Calaveras Creek confluence during July 1995. Water temperatures collected throughout each day ranged from 18 to 29 °C (DFG 1996). Water from the Central Valley flows through this watershed due to releases from the South Bay Aqueduct. This may confuse returning fish and cause straying, but the extent of this straying has not been determined (Gunther and others 2000).

Hydrology

The lower 12 miles of Alameda Creek may become dry during the summer, so flow may be a fish passage issue. The average yearly rainfall for Alameda Creek is about 15 inches (Alameda Creek Alliance 2000). Diversions at the Upper Alameda Creek Diversion Dam (not the main stem), may divert as much as 85 percent of the flow out of the creek (Gunther and others 2000). In 1957 a survey by the California Department of Forestry found flow to range from 6 cubic feet per second to none in May. A 1996 DFG stream inventory reported flows of 3 cfs at the SWTP and 1.5 cfs just upstream of Calaveras Creek. In the same report, temperatures of 18 to 24 °C were recorded for the same reach.

There are eight US Geological Survey (USGS) gaging stations on Alameda Creek and its tributaries; flow data from 1891 are available from the oldest gaging station (Figure E-2). The other stations have data starting from 1912, 1957, 1964, 1994, and 1995 (USGS 2000a-h).

Figure E-2 Mean monthly flows from 1891 to 2000 on Alameda Creek at Niles

Habitat Quality

The 12-mile section of the creek that runs from San Francisco Bay to the mouth of Niles Canyon is a straight flood control channel. It has a paved bike path on the south side and a gravel equestrian road on the north side. The banks are lined with riprap, and there is little vegetation (Horil 2001). Some spawning has been observed downstream of the BART Weir in this section, but the hatching success is estimated to be low due to gravel siltation, frequent flow fluctuation, and loss of channel features such as pools, riffles, and riparian bank vegetation as a result of the extensive channelization of the creek bed for flood control (Gunther and others 2000). Rearing could not occur in most of this reach. However, this reach may be important habitat for transition between freshwater and ocean habitat because it is tidally influenced (Gunther and others 2000).

The Niles Canyon reach of the river may have supported rainbow trout in the past. Today the lower section may provide suitable habitat, but high temperatures decrease its value. Increased flow due to releases from the South Bay Aqueduct operations in Niles Canyon may help offset the effects of the increased temperature. Flow here is also augmented by releases for municipal water supply operations. Trout were observed in tributaries of this reach in 1999 (Gunther and others 2000). Although high water temperatures are a limiting factor, rearing conditions in wet water years could be quite different. Augmented summer flows in the reach potentially provide fast-water habitat that may allow trout to obtain sufficient food to withstand the warmer temperature (Gunther and others 2000). With sufficient food present, Central Coast steelhead and rainbow trout may tolerate warmer water temperatures than suggested in much of the literature (Smith 1999). Local anglers continue to catch rainbow trout in the Niles Canyon reach, despite the cessation of trout stocking several years ago (Alexander 2003), suggesting possible successful rearing (Jeff Miller 2003 pers comm).

The Sunol Valley reach of Alameda Creek has a wide, braided channel, which results in shallow flow and presents passage issues at low flows (Gunther and others 2000). There is good spawning substrate in this reach. However, rearing would be prevented by low summer flows and high temperatures caused by a lack of riparian cover. With streamflow augumentation, summer temperatures could be lowered, and this reach could support steelhead/rainbow trout (Gunther and others 2000). Others might argue that because of the alluvial nature of the valley substrates and possible infiltration into nearby quarries it would be impractical to provide enough water to keep this reach wetted (SFPUC).

The Lower Ohlone reach of Alameda Creek supports a self-sustaining population of rainbow trout, which would indicate good habitat. The stream dries in spots during the summer, but pools provide adequate habitat (Gunther and others 2000). The Upper Ohlone reach has a relatively healthy hydrology and supports a population of rainbow trout. This reach dries in the summer upstream of the confluence with Valpe Creek (Gunther and others 2000).

Habitat Data

Habitat data for most of the Alameda Creek watershed is available in an assessment of the creek done for the Alameda Creek Fisheries Restoration Workgroup (Gunther and others 2000). Older habitat data is available for small portions of the creek. A 1988 DFG fish sampling report includes habitat data for the area immediately upstream of the Calaveras Creek and for a reach near the Wooden Bridge Creek crossing (DFG 1988). Temperature, pH, and dissolved oxygen (DO) measurements were collected in 1973 at six points in Alameda Creek (Aceituno and others date unknown). A May 1957 DFG stream survey contains channel, temperature, and flow data. A 1996 DFG stream inventory of the creek contains temperature, flow, and channel information as well as gravel location and embeddedness. Anecdotal habitat information is available (Spliethoff 2000, Alameda Creek Alliance 2000).

The SFPUC has collected habitat data that has been reported in its annual Aquatic Resource Monitoring and Aerial Survey Reports. Additional information was provided in the SFPUC proposals to remove Niles and Sunol dams.

The most recent habitat typing was done by Hanson Environmental, Inc. (2002). The reconnaissance level study examined seven reaches between the flood control channel and Sunol Regional Park. The measured instream features included pools, riffles, runs, substrate type, water velocity, and water depth. Data for each of seven reaches were broken into percent habitat type availability and, within that, percent of suitability. Habitat constraints and limiting factors that were listed for the various reaches included water velocity, water depth, and availability of suitable spawning gravel.

Fisheries and Restoration Projects

The Alameda Creek Steelhead Restoration Proposal, sponsored by the Alameda Creek Fisheries Restoration Workgroup, recommends removing barriers to anadromous fish migration in the Alameda Creek watershed. The workgroup published a report of habitat conditions and barrier information. The East Bay Regional Parks District (EBRPD) has removed two concrete swim dams at a cost of $25,000 each (Laura Kilgour 2003 Sep 4 pers comm). The SFPUC has announced that in 2005 it will remove two dams (Sunol Dam and Niles Dam) in the Niles Canyon reach of Alameda Creek (Laura Kilgour 2003 Sep 4 pers comm). The Alameda County Flood Control District and Alameda County Water District have teamed up to apply for funds from US Army Corps of Engineers (USACE) Section 1135 program, Projects for Improvement of the Environment. This money would be used to modify the lower flood control channel dams for fish passage.

Several projects are under way on Arroyo Mocho that include facilities for fish passage. Zone 7 Water Agency is planning to install a fish screen on their new inflatable dam project. Zone 7 is also constructing fish ladders for steelhead passage in their Arroyo Mocho Widening/Arroyo Las Positas Realignment Project. The Lawrence Livermore Lab removed and replaced a concrete roadway crossing with a new bridge in 2004 (Gary Stern 2005 Mar 31 pers comm).

In recent years, there have been various rescue efforts to transport steelhead around barriers, to collect fertilized eggs, rear the young, and release them in the Sunol Park area (Gunther and others 2000). The SFPUC, in cooperation with the Alameda Creek Fisheries Restoration Workgroup, has plans to transplant a yet-to-be-determined number of radio-tagged rainbow trout from its two East Bay reservoirs into upper Alameda Creek (in the vicinity of the Sunol Valley Water Treatment Plant or the Sunol-Ohlone Regional Park). The study, which was to begin during the 2003-2004 spawning season, will attempt to answer several questions related to that portion of the creek's suitability for sustaining salmonids.

Alameda Creek Tributaries – Alameda and Santa Clara Counties

Arroyo Valle

Potential Impediments to Anadromous Fish Migration

Lake Del Valle is the only reservoir on Arroyo Valle, and Del Valle Dam is a complete barrier to anadromous fish passage. There is also a drop structure in the creek, but it is not considered to be a passage problem.

General Description

Arroyo Valle begins on the west slopes of Black Mountain near the Santa Clara / Stanislaus County line and runs 33 miles northwest to its confluence with Arroyo de la Laguna at RM 6. Arroyo de la Laguna is a tributary to Alameda Creek at RM 17.

Fish Populations

In 1962 "steelhead/rainbow" trout were found by Skinner (cited in Gunther and others 2000) in Arroyo Valle. Today there are self-sustaining populations of rainbow trout in tributaries to Lake Del Valle (Gunther and others 2000). In a 1957 stream survey done by DFG before Del Valle Dam was built, rainbow trout were observed in the upper reaches of the creek. DFG personnel conducting the survey assessed these trout to be resident, not anadromous, trout (DFG 1957). There is no evidence of rainbow trout being stocked in Arroyo Valle before the dam was built, but steelhead rescued from Uvas Creek in Santa Clara County were planted in Arroyo Valle (DFG 1957).

The EBRPD and DFG operate a put-and-take rainbow trout fishery in Lake Del Valle, which is owned and operated by DWR. In 1973, DFG planted 45,672 rainbow trout followed by an additional 59,944 trout in 1994 (DFG 1974 and 1975). In 1990, EBRPD planted 54,144 pounds of rainbow trout and DFG planted 28,700 pounds (DFG 1991). These fish are "planted from September to April or May" (DFG 1991). Sampling of fish in Lake Del Valle by DFG in 1972, 1973, 1976, and 1977 recovered stocked rainbow trout. Rainbow trout are also stocked at Shadow Cliffs Regional Recreation Area (Gunther and others 2000).

Water Quality

Water temperatures in the creek downstream of Lake Del Valle are high. Flow in the lower 11 miles of the creek is heavily influenced by releases from the reservoir. Because it is managed for groundwater recharge, flows in the lower reach are probably erratic (Gunther and others 2000). In 1972 Zone 7 of the ACFC & WCD agreed to release 10 cfs of water from Del Valle

Dam between 24 Apr and 30 Jun. This was arranged so that DFG could stock this area with fish (Zone 7 1972).

Temperature and DO are also problems in Arroyo Valle. In 1973, DFG measured DO and water temperature in Lake Del Valle near the dam. DO ranged from 5.2 to 10.7 mg/L, and temperature ranged from 65 °F at the surface to 51 °F at a depth of 44 feet. DFG fish population surveys between 1972 and 1977 contain minimal temperature data. During a May 1986 survey of the creek downstream of Lake Del Valle, a temperature of 72 °F was recorded (Gray 1986).

Hydrology

Arroyo Valle is generally dry during the summer. A DFG survey done in mid-May 1957 reported no flow downstream of Pleasanton. Flow data from 1957 to 1985 are available from a USGS gage on Arroyo Valle at Pleasanton (Figure E-3) (USGS 2002).

Figure E-3 Mean monthly flows from 1957 to 1985 on Arroyo Valle at Pleasanton

Habitat Quality

Only the uppermost portion of Arroyo Valle has suitable spawning gravel. The portion of the creek downstream of Lake Del Valle is channelized. Water temperatures in the lower reach of the creek are high because there is no shade. There are also high levels of sediment. The portion of this creek accessible to anadromous fish does not offer good spawning or rearing habitat (Gunther and others 2000). A 1957 DFG stream survey of Arroyo Valle described the lower portion of the creek as of little value for fish life, but the survey said the extreme headwaters could “provide fine habitat for trout.” In a 1986 DFG survey of the area 2,000 feet downstream of Del Valle Dam the habitat was found to be “very good.” It was described as having “a large amount of undercut banks, roots and boulders as well as good clean gravel.” Sycamores, alders, and cottonwoods provided an estimated 30 percent canopy cover in this reach (Gray 1986).

Habitat Data

Most of the available habitat data is from habitat surveys done in 1999 in conjunction with An Assessment of the Potential for Restoring a Viable Steelhead Trout Population in the Alameda Creek Watershed, a report published by the Alameda Creek Fisheries Restoration Workgroup. The report also cites a 1962 survey (Gunther and others 2000). According to the assessment, Arroyo Valle is a channelized urban stream from its mouth to Shadow Cliffs Regional Recreation Area; it is predominantly bordered by riprap. In 1986, DFG conducted a survey of the creek 2,000 feet downstream of Del Valle Dam. Some habitat data was collected during the survey (Gray 1986).

Fisheries and Restoration Projects

During the 1986-1987 drawdown, in which the lake level was lowered, EBRPD, DFG, DWR, and area sport fishing clubs conducted fish habitat work at Lake Del Valle. They planted 250 arroyo willow trees in the southern portion of the reservoir where the banks were devoid of cover. They also anchored brush in the reservoir to provide cover for fish. About 600 to 800 hardwood limbs were anchored as well. Local Boy Scout troops also helped by collecting 200 to 300 Christmas trees and anchoring them in the reservoir, where they would be in slow, shallow water during high water. They were placed in such a way that they would be easy to replace once decomposed (EBRPD 1987).

Arroyo Mocho

Potential Impediments to Anadromous Fish Migration

There are two drop structures and one road crossing on Arroyo Mocho.

General Description

Arroyo Mocho is part of the Alameda Creek watershed. It is 10 miles long and drains into Arroyo de la Laguna at RM 7. Arroyo de la Laguna is a tributary to Alameda Creek at RM 17. Arroyo Mocho runs through the Livermore and Amador valleys.

Fish Populations

"Steelhead/rainbow" trout were documented in Arroyo Mocho in 1962, and today there are self-sustaining populations in the creek (Gunther and others 2000). A 1976 DFG survey found rainbow trout at three places on the creek: Lawrence Livermore pumping station, Cedar Brook Ranch, and Mines Road. A total of 44 rainbow trout were caught at the three sites on 3 February (DFG 1976). In 1978 DFG approved a request to stock trout in a one-mile reach of the creek that runs through Robertson Park in Livermore. Zone 7 of the ACFC & WCD has allocated water from the South Bay Aqueduct for Arroyo Mocho in adequate amounts to sustain the stocked trout (DFG 1978). There are no estimates of the size of the fish run in Arroyo Mocho.

Water Quality/Hydrology

Flow and temperature are the biggest water quality issues in Arroyo Mocho. Quarries and groundwater recharge have altered the natural flow in the creek. During the summer, this tributary to Alameda Creek is one of the driest and most arid (see Figure E-4). Arroyo Mocho becomes two distinct sections separated by about 200 yards of creek bed in a gravel quarry area in Pleasanton. That section remains dry for most of the summer. Downstream of this dry reach, water is supplied to Arroyo Mocho by releases from Lawrence Livermore National Laboratories and discharges from quarries (Gunther and others 2000). In the flood control channel reach upstream of the dry area, water supplied by DWR via the South Bay Aqueduct is released into the creek for groundwater recharge (Gunther and others 2000). Summer flows in the upper reaches of the creek are almost entirely due to water purchased from the State Water Project. Because this water is managed for groundwater recharge, it rarely continues downstream. Water infiltration rates are high in the Livermore Valley, so any excess SWP water is absorbed through the channel bottom and does not flow continuously downstream (Gunther and others 2000).

Figure E-4 Mean monthly flows from 1962 to 1985 on Arroyo Mocho at Pleasanton

Zone 7 of the ACFC & WCD operates three gaging stations in the Arroyo Mocho watershed. Data from these gages, combined with an estimate for quarry pond releases, has been used to estimate flow and determine its adequacy for fish migration. The data suggest there is a range of 20 to 40 cfs in the Pleasanton reach of the flood control channel from January through March and flows are minimal in April and May. During a field survey in October 1999, flows in the upper and lower flood control channel were 10 to 12 cfs. This level of flow appeared to be sufficient for fish migration. Further analysis of the available data led Gunther to the conclusion that there is “a continuous wetted channel adequate for fish migration” through January and March and around storm events (Gunther and others 2000). The quality of water when it is present does not appear to be a limiting factor to anadromous fish populations in Arroyo Mocho (Gunther and others 2000).

Habitat Quality

Downstream of Wente Road, the creek channel is channelized and riprapped but it does have a natural bottom. The lower portion is not considered to be suitable spawning or rearing habitat due to lack of shade and high sedimentation. Between Murrieta’s Well and the South Bay Aqueduct there is a section of natural channel with varying shade. The water temperature here was 21 °C according to a 2000 stream survey and there is predominately a gravel and cobble substrate (Gunther and others. 2000). From the aqueduct to the Mines Road Bridge, flow is low and there is generally less than 25 percent shade. However, temperatures were 20 °C in this reach during a 2000 stream survey, and trout have been documented here (Gunther and others 2000). Boulders become more common upstream of this section. Near the Alameda-Santa Clara County line, the creek becomes largely dry with sections shaded mostly by small willows (Gunther and others 2000).

Habitat Data

Most of the habitat information available is from stream surveys done for a report, An Assessment of the Potential for Restoring a Viable Steelhead Trout Population in the Alameda Creek Watershed, published in February 2000 by the Alameda Creek Fisheries Restoration Workgroup. There are also 1964 to 1999 flow data available from the USGS gaging station on Arroyo Mocho near Livermore (USGS 2000).

Fisheries and Restoration Projects

Two fish passage enhancement projects have been undertaken. A drop structure at RM 0 and a road crossing at RM 12 have been removed.

Calaveras Creek

Potential Impediments to Anadromous Fish Migration

Calaveras Dam is the only barrier on Calaveras Creek, and it is impassable.

General Description

Calaveras Creek is a tributary to Upper Alameda Creek at RM 26. It is 5.4-miles long and has one major reservoir, Calaveras Reservoir, which it empties into from the southeast. The reservoir is fed by natural streams, including the Aroyo Hondo entering from east of the reservoir and north of Calaveras Creek. The reservoir is also fed by a pipeline, which delivers Alameda Creek water from a diversion at the Alameda Creek Diversion Dam on Alameda Creek (Gunther and others 2000).

Fish Populations

Calaveras Creek is a tributary to Alameda Creek upstream of several impediments to fish migration. At least one of these barriers is considered to be impassable. This eliminates any anadromous fish from gaining access to Calaveras Creek. There are self-sustaining populations of rainbow trout upstream of Calaveras Reservoir, in the tributary Arroyo Hondo, and possibly in Smith and Isabel creeks. These populations are probably derived from coastal steelhead, which were trapped in the upper watershed (Gunther and others 2000). According to the Alameda Creek Fisheries Restoration Workgroup report, there were fish surveys of various reaches of Calaveras Creek done in 1905, 1938, 1972, and 1977 (Gunther and others 2000). SFPUC Aquatic Resource Monitoring Reports have documented fish populations in Calaveras Creek, downstream of Calaveras Reservoir, since 1998. A study to estimate the size of the rainbow trout population was scheduled to begin in 2004 (SFPUC 2004 Apr pers comm).

Water Quality

Summer water temperature is relatively high in the creek downstream of Calaveras Dam (Gunther and others 2000). A 1965 limnological study of Calaveras Reservoir contains data about temperature, turbidity, DO, and pH of the water at four sites in the reservoir. Temperatures ranged from 75.5 °F to 47.7 °F; stratification did occur. DO ranged from 1.6 to 9.0 ppm, and pH was 7.5 to 8.5 (DFG 1965). In 1973 DFG recorded water temperature during three fish samplings in the reservoir. The results were 72 °F in late May, 76 °F in mid June, and 62 °F in October. SFPUC Aquatic Resource Monitoring Reports have also been collecting water quality parameters.

Hydrology

During a 15 Apr 1988 fish sampling by DFG, flow in Calaveras Creek was measured at 0.068 cfs. The same point measured in September of the same year had a flow of 0.594 cfs. In April flow was not continuous from Calaveras Dam to the confluence with Alameda Creek. Flow was intermittent upstream of the Hetch Hetchy pipe abutment. While USGS does not have a flow gage on Calaveras Creek, there is one on Alameda Creek downstream of its confluence with Calaveras Creek with data available from 1995 to 1999 (USGS 2000).

Habitat Quality

A 1995 stream survey by DFG found that the area between Calaveras Dam and the confluence with Alameda Creek has a very steep gradient with the substrate being mostly very large boulders. It is believed that passage through this section is difficult or impossible at most flows and is therefore considered “unsuitable for the re-establishment of a trout population” (DFG 1996).

Habitat Data

Other than limnological data, very little habitat data are available for Calaveras Creek. No vegetation data was found. A brief mention of channel gradient and substrate can be found in An Assessment of the Potential for Restoring a Viable Steelhead Trout Population in the Alameda Creek Watershed (Gunther and others 2000).

Fish Passage and Restoration Projects

No restoration or fishery projects are being carried out at this time. However, the SFPUC is carrying out several ongoing studies within the watershed. The Alameda Creek Aquatic Resource Monitoring is an ongoing study in Calaveras Creek downstream of the dam. Additionally, there are four ongoing projects in Arroyo Hondo: an Aquatic Resource Monitoring project; a Fish Trapping Study; a Trout Predation Study, and the Reservoir Trout Population Size Study (SFPUC 2003 pers comm).

Arroyo de la Laguna

Arroyo de la Laguna is a tributary to Alameda Creek parallel to Interstate 680. There are no identified barriers on this tributary, and flow appears to be adequate for migration to other tributaries. Downstream of its confluence with Arroyo Mocho, Arroyo de la Laguna has poor breeding and rearing habitat. The substrate is mostly sand. There is poor pool development, and summer temperatures may be high. Sections of Arroyo de la Laguna near Arroyo Mocho have been channelized for flood control. A 1963 survey found rainbow trout in Arroyo de la Laguna; however, DFG fish surveys in 1976 and 1986 did not recover rainbow trout (DFG 1986). Only warm water, nongame fish were caught in these surveys. Some temperature and flow data are available in these fish surveys for limited portions of the creek. Downstream of Pleasanton, Arroyo de la Laguna has had erosion problems. The lowermost portion of the creek may be suitable for trout, and there is little information about the upper reaches (Gunther and others 2000).

Pirate Creek

Pirate Creek is a tributary to Alameda Creek in the Sunol Valley. Rainbow trout were observed in the lower reaches of Pirate Creek during sampling by Alameda County in 1999 (Gunther and others 2000).

San Antonio Creek

San Antonio Creek is a tributary to Alameda Creek just upstream of the Interstate 680 crossing. Historically, there were steelhead in San Antonio Creek but “by the early 1960s, Alameda Creek steelhead runs were essentially eradicated” (DFG 1978). James H. Turner Dam creates San Antonio Reservoir and blocks access to San Antonio, La Costa, and Indian Creek watersheds all of which had steelhead historically (Leidy 1984). Self-sustaining populations of rainbow trout are in tributaries to the reservoir, and habitat upstream of the reservoir is considered potential steelhead habitat (Gunther and others. 2000). A 1978 trout survey by DFG reported dense populations of young-of-year rainbow trout in San Antonio Creek upstream of the reservoir, in lower and upper La Costa Creek, and in lower and middle Indian Creek.

The SFPUC has conducted work in San Antonio, La Costa, and Indian creeks. Two years of fish trapping data (now an ongoing annual project), for both upstream and downstream moving fishes in San Antonio Creek and a single year of data for Indian Creek have been collected. Rearing habitat was evaluated by an aerial survey. A trout predation pilot study was conducted in 2003, and a study to estimate the size of the rainbow trout population is anticipated (SFPUC 2003 pers comm).

Stoneybrook Creek

Stoneybrook Creek is a tributary to Alameda Creek at Palomares Road. DFG found rainbow trout in Stoneybrook Creek in 1976. Rainbow trout have also been documented recently in the creek during sampling by the EBRPD. Temperatures in Stoneybrook Creek were consistently measured below 64.4 °F (18 °C) in summer 1999, which is within the suitable range for steelhead trout (Gunther and others 2000).

Valpe Creek

Valpe Creek is a tributary to upper Alameda Creek. Rainbow trout were seen in Valpe Creek in 1999 (Gunther and others. 2000).

Welsh Creek

Welsh Creek is a tributary to Alameda Creek in Sunol Valley. Alameda County found rainbow trout in the creek during sampling in 1999. There is a natural barrier 0.3 miles from the confluence with Alameda Creek, which blocks access to the rest of the creek (Gunther and others 2000).

Sinbad Creek

Sinbad Creek is a tributary to Arroyo de la Laguna near its confluence with Alameda Creek. This creek historically had steelhead in it but does not have a persistent population of rainbow trout. Temperatures in Sinbad Creek were consistently measured at below 64.4 °F in summer 1999 (Gunther and others 2000). A preliminary assessment of potential steelhead habitat in Sinbad Creek revealed that the entire lower 5 miles of the creek has gravel suitable for spawning. Winter precipitation may provide flows to sustain adult steelhead migration upstream, and isolated pools may provide suitable rearing habitat for juvenile steelhead (Herron, King and McDonald 2003). Restoring Sinbad Creek would involve addressing eleven road crossings and six dams in the first 3.5 miles of creek.

San Francisquito Creek – Santa Clara and San Mateo Counties

Potential Impediments to Anadromous Fish Migration

San Francisquito Watershed creeks have many barriers to fish passage. The Watershed Council has prepared an assessment of those barriers which fall into five major categories: dam, weir, bridge apron, culvert, and “other” (a drop structure, a concrete low water road crossing, and a fence) that could impede anadromous fish migration between Searsville Dam and its discharge into San Francisco Bay. Searsville Dam blocks the migration of steelhead trout to the tributaries upstream of Searsville Lake.

General Description

The San Francisquito Creek watershed extends 45 square miles from the Santa Cruz Mountains to San Francisco Bay. Several creeks draining Skyline Ridge join together and form Searsville Lake in Portola Valley including Corte Madera Creek, Sausel Creek, Dennis Martin Creek, and Alambique Creek. San Francisquito Creek is formed downstream of Searsville Lake at the confluence of Corte Madera Creek with Bear Creek, which with its tributaries of Dry Creek, Bear Gulch, and West Union Creek drains the Town of Woodside. Los Trancos Creek is a downstream tributary of San Francisquito. The creek continues through the hills above Stanford University, then between Palo Alto and Menlo Park and East Palo Alto and finally flows into San Francisco Bay.

Fish Populations

Historically, in addition to steelhead trout, San Francisquito Creek supported a run of Chinook salmon (SFEP 1997). There are no records of Central California coho salmon in the San Francisquito watershed; however, because they are widely distributed, it is possible that they may have inhabited the watershed (Launer and Spain 1998). Today, steelhead trout are the only salmonids inhabiting the San Francisquito watershed. Steelhead trout are found in various tributaries of the Bear Creek watershed (Smith and Harden 2001) and Los Trancos Creek (Launer and Spain 1998), and resident rainbow trout flourish in various tributary creeks upstream of Searsville Lake. Fish surveys have been performed by DFG from 1974 to 1996. Fish surveys from 1974, 1976, and 1981 are available from the San Francisquito Creek Joint Powers Authority (JPA).

Water Quality

The water in San Francisquito Creek has a high silt load and high levels of the pesticide diazinon (USEPA 1998), a widely used organophosphate. As it passes through urban Palo Alto, the rural towns of Woodside and Portola Valley, Menlo Park, and East Palo Alto, the creek receives storm water discharges, which can contain various levels of pesticides, oils, heavy metals and other contaminants. San Francisquito Creek Coordinated Resource Management and Planning staff and volunteers and the city of Palo Alto sampled and analyzed water for various pesticides and heavy metals in the San Francisquito watershed from 1997 to 1998 (San Francisquito Creek San Francisquito Watershed Council 2002). With financial and technical support from the City of Palo Alto and Stanford University, three long-term monitoring stations are operational: (1) Newell Bridge, (2) San Francisquito at Piers Lane, and (3) Los Trancos at Piers Lane. A fourth is being installed on Bear Creek.

Hydrology

The flows in San Francisquito Creek are highly seasonal (Figure E-5). USGS maintains a streamflow gage at Stanford University, and records are available from 1930 to 1941 and since 1950 (USGS 2000). Historical flows range from peaks of more than 1,500 cfs in the winter to less than 0.5 cfs during summer and early fall (USGS 2000). The creek reportedly runs dry in the summer (Cities of Menlo Park, Palo Alto, East Palo Alto, San Mateo County and the Santa Clara County Water District 2000). One USGS gaging station at Stanford University has data available from 1930 to 1941 and since 1950 (USGS Nov. 28, 2000). Historical flows range from the flood of record, February 1998, when flows ran 7,200 cfs to less than 0.5 cfs during summer and early fall (USGS 2002). Downstream of Junipero Serra Boulevard, the creek reportedly runs dry in the summer (Santa Clara Basin Watershed Management Initiative Watershed Assessment Report 2003).

Figure E-5 Mean monthly flows from 1930 to 2000 on San Francisquito Creek at Stanford University

Habitat Quality

The spawning habitat quality of San Francisquito Creek is variable as it flows from the minimally developed upper watershed lands of Stanford University through the downstream urban areas of Palo Alto, Menlo Park and East Palo Alto and the main Stanford campus. The reach of San Francisquito Creek between Junipero Serra Boulevard and Highway 101 has been described as suboptimal spawning habitat as most of this area is dominated by fine materials such as sand and by gravels and cobbles in the upstream area. This area appears to provide primarily migration habitat for steelhead, although several barriers to migration exist (Cities of Menlo Park, Palo Alto, East Palo Alto, San Mateo County and the Santa Clara County Water District 2000 and Smith and Harden 2001).

The existing shading, summer water temperatures, and spawning habitat have been described as good in the Bear Creek watershed. Upper portions of the watershed are protected in parks or California Water Service Company lands. Streambeds have been described as clean; however, streamflows were low to extremely low in the summer (Smith and Harden 2001; SFRWQCB 2003; SCBWMI WAR, Appendix D 2003).

The upper San Francisquito watershed has been the focus of fish surveys conducted during the 1990s. Bear Creek and Los Trancos Creek contained the largest number of steelhead and seemed to provide the most significant spawning grounds for the species (Cities of Menlo Park, Palo Alto, East Palo Alto, San Mateo County and the Santa Clara County Water District 2000).

Habitat Data

Studies include Stanford University's surveys in 1997, 1998, and 1999 of biotic diversity within various parts of the watershed (San Francisquito Watershed Council 2002), and the San Francisquito Creek Bank Stabilization and Revegetation Master Plan contains a discussion of existing habitat conditions between Junipero Serra Boulevard and Highway 101. The Watershed Management Plan Watershed Characteristics Report, vol. 1, and Watershed Assessment Report, vol. 2 (SCBWMI 2003) also reported abundant habitat data.

Fisheries and Restoration Projects

San Francisquito Creek lies within many jurisdictions, and, as a result, there are many entities involved in addressing drainage and environmental issues in the watershed. An attempt to build a consensus among the various interests led to the formation in 1993 of the San Francisquito Creek Watershed Council (formerly known as the San Francisquito Creek Coordinated Resource Management and Planning group). The SFWC includes more than 40 government agencies and community organizations (Peninsula Conservation Center Foundation 2000).

The SFWC hired a streamkeeper, a watershed coordinator, and an outreach coordinator. The SFWC also administers three main on-the-ground restoration projects: (1) a volunteer-based riparian vegetation project with nine demonstration sites throughout the watershed, (2) a native plant nursery that supplies plants grown from locally collected seed for the revegetation sites, and (3) a working group called the Steelhead Task Force that develops and implements steelhead habitat restoration and protection projects. It has also produced several documents to facilitate identification and prioritization of restoration opportunities in the watershed, including the 1998 Reconnaissance Investigation Report of San Francisquito Creek, the 2001 Adult Steelhead Passage in the Bear Creek Watershed, and the 2002 Long-term Monitoring and Assessment Plan.

A JPA was formed in May 1999 between the cities of East Palo Alto, Palo Alto, and Menlo Park as well as the Santa Clara Valley Water District and the San Mateo Flood Control District. The San Francisquito Watershed Council and Stanford University are associate members. The JPA is examining flood issues within the San Francisquito watershed (San Francisquito Watershed Council 2002).

The Santa Clara Basin Watershed Management Initiative was established in 1996 by Environmental Protection Agency, the State Water Resources Control Board, and the San Francisco Bay Regional Water Quality Control Board. Water quality issues are being examined in the basin, which includes the San Francisquito Creek watershed (San Francisquito Creek CRMP 2000 and the Santa Clara Basin Watershed Management Initiative: Watershed Characteristics Report and Watershed Assessment Report 2003).

The JPA was awarded $112,000 from the California Coastal Conservancy in 2001 to conduct planning and design for Bank Stabilization and Revegetation Demonstration Projects. Northwest Hydraulic Consultants was hired in March 2002 to conduct the planning and conceptual design for up to five high-priority sites. The sites have been narrowed to two stretches, involving multiple landowners on both sides of the creek.

The JPA and the Town of Portola Valley were jointly awarded $72,000 from DWR in March 2003 to expand the Bank Stabilization and Revegetation Master Plan to Corte Madera Creek.

The Searsville Lake Sediment Impact Study was prepared for Stanford University and was completed in 2001. After additional analysis, the JPA accepted the study in May 2003. This project analyzed downstream sediment impacts including existing conditions and conditions based on various scenarios of filling or lowering Searsville Dam (San Francisquito Creek CRMP 2000).

A Comparison of Water Quality in Urban and Rural Stormwater Runoff study was funded by San Mateo County and was completed in October 2000. This project compares pollutants in storm water runoff discharged in urban and rural areas of the watershed (San Francisquito Creek CRMP 2002 quoting H28, Sipes).

In December of 2000, eight watershed stakeholder agencies (co-permittees: Woodside, Portola Valley, San Mateo County Flood, Santa Clara County, Santa Clara Valley Water District, Palo Alto, Menlo Park, and East Palo Alto) were required by the State Water Resource Control Board (SWRCB) to conduct a watershed analysis and an assessment of management practices, and to prepare and implement a sediment reduction plan within the San Francisquito Creek watershed through their National Pollutant Discharge Elimination System permitting process.

The co-permittees asked the JPA to oversee submitting a grant and to manage a project that would meet these requirements. The grant includes a “cost share matching fund” from each co-permittee.

In January 2001, the JPA board authorized submittal of the grant through Resolution #01-1-25. The SWRCB notified the JPA in September of 2001 that the grant had been awarded.

At the request of stakeholder agencies and the SWRCB, the JPA created a technical advisory committee to assist in developing the request for proposals, scope of work, and to review the project as it was completed. The technical advisory committee meets at least quarterly to review and advise the consultant’s work.

In November 2002, the JPA board authorized the executive director to enter into a $235,000 contract for a Watershed Analysis and Sediment Reduction Plan Project under a Costa-Machado Water Act of 2000 (Proposition 13) grant award. The contract with the State was received in February 2003. The JPA has also entered into agreements with the eight co-permittees for their portion of the project cost-share.

San Francisquito Creek Tributary – Santa Clara and San Mateo Counties

Los Trancos Subwatershed

Potential Impediments to Anadromous Fish Migration

There are a series of weirs that are easily passed on Los Trancos Creek near and under Highway 280. There are no significant barriers between the mouth and the Stanford University Felt Lake Diversion Dam, which has a fish ladder that allows migration to 3.5 miles of potential habitat. However, there are three difficult barriers within this reach of potential habitat, including a 6-foot high concrete flashboard dam with concrete-lined basin 0.1 miles upstream of the Los Trancos Road and Alpine Road intersection. Additionally, there is a double box culvert at the Los Trancos Road crossing upstream of Alpine Road and another double box culvert on the Emergency Fire Access Road 0.1 miles downstream of the second Los Trancos Road crossing (Smith and Harden 2001).

General Description

Los Trancos Creek is a tributary of San Francisquito Creek that is the border between Santa Clara and San Mateo counties, entering San Francisquito Creek about RM 8.3. Los Trancos Creek is about 8 miles long, and its total watershed encompasses about 7.5 square miles, ranging in elevation from 500 feet at its headwaters to 200 feet at its confluence with San Francisquito Creek.

Fish Populations

Steelhead trout are found throughout the San Francisquito Creek watershed, including Los Trancos Creek. One pass electroshocking samples in 1997-1999 found that Los Trancos has an abundance of steelhead 4-5 times higher than that of San Francisquito Creek itself (Launer and Spain 1998, Launer and Holtgrieve 2000).

Water Quality/Hydrology

Streamflow in Los Trancos Creek is highly seasonal and fluctuates sharply in response to winter storms. USGS maintained a stream gage station at Stanford University that measured daily streamflow from 1930 to 1941 (Figure E-6) (USGS 2002).

Figure E-6 Mean monthly flows from 1930 to 1941 on Los Trancos Creek near Stanford University

Habitat Quality

Spawning habitat is common in Los Trancos Creek, and probably provides some fry for stretches of San Francisquito Creek (Harvey and Associates 2001). Rearing habitat also exists in Los Trancos Creek but is constrained by very low late-summer streamflows, even in wet years (Harvey and Associates 2001). Los Trancos Creek downstream of the Stanford Felt Lake Diversion Dam has a steep enough gradient to create riffles and runs likely to support moderate insect production and steelhead feeding even under late summer flows (Harvey and Associates 2001). All of the streams in the San Francisquito Creek watershed run turbid with storm flows, but Los Trancos

Creek, with a relatively undeveloped watershed, appears to clear most rapidly after storms and has relatively clean substrate (Harvey and Associates 2001).

Habitat Data

Habitat Data for Los Trancos Creek is limited. More information is available concerning habitat data for San Francisquito Creek (see San Francisquito Creek in this appendix).

Hankinson and Smith from San Jose State University are doing studies to determine genetic relationships among different populations of South San Francisco Bay and Central California Coast steelhead/rainbow trout and the relative influence of hatchery stocking on population genetics. Their study reach includes Los Trancos Creek. According to Geoff Brosseau, Ecterra, Palo Alto, California, the study, titled Genetic Relationships among Steelhead Rainbow Trout Populations in Tributaries to South San Francisco Bay (Phase 1) was completed (Geoff Brosseau 2003 Jul pers comm).

Some habitat data for Los Trancos Creek are available in Harvey and Associates (2001) Searsville Lake Sediment Impact Study: Biotic Resources Synthesis Report.

This report is available online at http://facilities.stanford.edu/searsville/draft/biotic_resources.pdf.

Long-term water quality monitoring has been conducted to characterize wet season conditions at Piers Lane. Data from this study are available from Geoff Brosseau, Aceterra, Palo Alto, California.

Fisheries and Restoration Projects

Stanford University is working with DFG to improve the fish ladder at the Felt Lake Diversion Dam, owned by the university, so that it passes fish more readily. Modifications to the fish ladder are estimated to cost around $1 million, including planning, permitting, and construction. The implementation schedule is contingent upon the university’s ability to secure a funding source to share the cost of the project, but if grant funding is available, the project could begin as soon as spring of 2004.

In March 2002 the San Francisquito Creek JPA submitted a grant proposal to the American Rivers – NMFS Community-Based Restoration Program Partnership on behalf of the Watershed Council to fund a project to remove the old Los Trancos flashboard dam. The Watershed Council, tentatively, has been awarded $49,000 for the modification of the flashboard dam, with funding contingent upon the development of a conceptual plan, cost estimates, permitting, and landowner permissions. DWR’s FFPIP provided the conceptual plans and cost estimates to help secure funding for the project.

Marsh Creek, Contra Costa County

Potential Impediments to Anadromous Fish Migration

The lower Marsh Creek drop structure is a grade control structure about 4 miles upstream from the mouth of Marsh Creek at Big Break in the western Delta. This drop structure is the farthest downstream fish passage barrier in the watershed. Marsh Creek Dam is about 7 river miles upstream of the lower Marsh Creek drop structure and is also a major fish passage barrier. Sand Creek, a Marsh Creek tributary, contains a drop structure that is about 3 miles upstream of the Marsh Creek drop structure and impedes migration to perennial pools in upper Sand Creek. These pools are on protected land within the EBRPD's Black Diamond Mines Regional Park.

General Description

Marsh Creek flows for about 30 miles from its headwaters on the eastern flank of Mount Diablo to its mouth at Big Break in the western Delta and drains about 128 square miles. Tributaries of Marsh Creek include Briones, Dry, Deer, and Sand creeks. Marsh Creek and its tributaries flow through a variety of range, farm, and urban lands.

Fish Populations

There is little historical information on salmonid runs in Marsh Creek. Marsh Creek does appear to support reproducing runs of Chinook salmon. Scientists from the Natural Heritage Institute (NHI) observed adult Chinook salmon downstream of the lower Marsh Creek drop structure in the fall of 2002 and 2003. There is also an existing population of rainbow trout in the upper watershed (Robins and Cain 2002). NHI scientists also interviewed local anglers along Marsh Creek who have reported that salmon runs have numbered in the hundreds for at least five years (Robins and Cain 2002). These observations have been substantiated by a limited number of fisheries surveys. Slotton and others (1996) reported five juvenile Chinook salmon in lower Marsh Creek during water quality surveys. Additionally, according to Erika Cleugh, DFG biologist, 13 juvenile Chinook salmon (60-80 mm) were observed downstream of the lower Marsh Creek drop structure. It is unclear if Chinook salmon are successfully reproducing in Marsh Creek or if the juveniles migrated upstream from the Delta to rear in Marsh Creek.

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The NHI did a survey downstream of the Marsh Creek drop structure during a weekend in November 2005 and counted about 30 adult salmon. Some of these salmon were observed actively digging redds and spawning, while others were trying to gain passage over the drop structure. It is unknown if these salmon were hatchery fish or were wild stock.

Water Quality

Several factors have led to the degradation of water quality in the Marsh Creek watershed, including extensive agriculture development, urbanization, and mercury mining activities that began in the 1850s. Marsh Creek Reservoir has been closed to fishing since the mid-1980s due to high concentrations of mercury found in fish both in and upstream of the reservoir.

Hydrology

Streamflows in Marsh Creek fluctuate sharply in response to winter storms. Streamflow is highly seasonal, with the majority of flows occurring in the months of January and February (Figure E-7. The USGS has a stream gage in Byron that recorded peak streamflows from 1954-1983, daily streamflows from 1953-1983, and water quality samples in 1970.

Figure E-7 Mean monthly flows from 1953 to 1983 on Marsh Creek near Byron

Habitat Quality

The lower portion of Marsh Creek has poor habitat due to a lack of vegetation and gravels. There is riprap on the stream bottom that may be used for spawning (NHI 2001). Widespread clearing of vegetation in the 1960s for flood control purposes has created higher water temperatures, lower DO levels, and increased sediment loading (Robins and Cain 2002).

Despite the poor habitat quality in the lower reaches of Marsh Creek, Robins and Cain (2002) reports that multiple areas of suitable spawning habitat for fall-run Chinook salmon exist in the 7 miles of stream between Marsh Creek Dam and the lower Marsh Creek drop structure. This portion of lower Marsh Creek contains numerous regions of gravel and a narrow band of riparian woodland that forms a canopy over the channel that moderates stream temperatures. In a 2004 report, Levine and Stewart found that upstream of the lowest fish barrier there is suitable gravel quality, quantity, and vegetative cover to support Chinook salmon spawning. In addition, potential spawning and over-summering habitat for both steelhead and Chinook is available in the intermediate and upper zones of the watershed. The presence of rainbow trout in the upper Marsh Creek watershed suggests that there are suitable habitat conditions available (Robins and Cain 2002).

Habitat Data

NHI and the Delta Science Center at Big Break prepared The Past and Present Condition of the Marsh Creek Watershed (Robins and Cain 2002). This document contains a discussion of existing habitat conditions.
NHI has also prepared the Corridor Width Report, Parcel Inventory, and Conceptual Stream Corridor Master Plan for Marsh, Sand, and Deer Creeks in Brentwood, California (Walkling 2002). This document contains habitat information as well.

University of California Berkeley graduate students overseen by NHI performed vegetation surveys and pebble count surveys in 2001. Survey information is available from NHI.

The USGS stream gage in Brentwood collected water quality samples in 2000 (USGS 2002).

In 2004 Levine and Stewart via UC Berkeley prepared the following paper: Fall-Run Chinook Salmon Habitat Assessment: Lower Marsh Creek Contra Costa County. This paper documents habitat characteristics on a 1.2-mile reach of Marsh Creek upstream from the lowest fish barrier.

Fisheries and Restoration Projects

According to Rich Walkling of NHI in Berkeley, the following projects are planned or proposed: NHI, in partnership with the Delta Science Center and DWR's FPIP, received a $6,000 grant in 2002 from American Rivers and NOAA to develop a set of alternative designs for modifying or removing the lower Marsh Creek drop structure. This project will enable upstream migration of Marsh Creek's existing run of fall-run Chinook salmon and possibly steelhead trout. These designs will be specifically created for incorporation into corridor restoration plans being developed by NHI and the city of Brentwood.

In 2004 NHI and American Rivers secured approximately $22,000 from American Rivers/NMFS and $44,000 from the California Coastal Conservancy to complete the engineering design, construction documents, and permitting for the fish passage project on Marsh Creek. The design and permitting work will be complete by the summer of 2005.

NHI and the City of Brentwood have received $1.2 million from DWR and California State Parks to purchase the Griffith Parcel; 5 to 11 acres at the confluence of Marsh, Sand, and Deer creeks. Plans include widening and reshaping the channel to restore meander, improve riparian vegetation, and restore the floodplain.

CALFED has awarded $120,000 to NHI for a watershed assessment, water quality monitoring program, and identification of potential restoration projects.

The California Coastal Conservancy awarded NHI $30,000 for design of a creek corridor protection plan in Brentwood.

CALFED has funded the purchase and restoration of Dutch Slough. This restoration project involves restoring about 1,000 acres of shallow water tidal marsh at the mouth of Marsh Creek to the east of the current channel.

Contra Costa County Flood Control District has plans for several detention/retention basins in the watershed, including two on Sand Creek, and an expansion of the existing Marsh Creek reservoir a few miles upstream from Brentwood.

The Contra Costa County Flood Control and Water Conservation District plans to remove or redesign the drop structure on Sand Creek to facilitate fish passage if the lower Marsh Creek drop-structure is removed or modified to pass anadromous fish.

San Lorenzo Creek, Alameda County

Potential Impediments to Fish Passage

Various flood control and road projects have created potential impediments to fish passage, and have led to fragmentation and isolation of aquatic habitats. Palomares and Cull Creek are not accessible to anadromous steelhead due to the presence of Don Castro Dam, completed in 1965, and Cull Canyon Dam, completed in 1962. Both of these dams are impediments to fish migration, and both reservoirs provide habitat for introduced warm water species, such as bass, that prey on juvenile salmonids.

Only Castro Valley Creek, Crow Creek, and San Lorenzo Creek downstream of Don Castro Dam are accessible to steelhead. However, steelhead using these areas must pass through a 3.9-mile concrete channel from near the San Francisco Bay to Foothill Boulevard constructed by the USACE between 1953 and 1962. This channel impedes steelhead passage under most flow conditions (Kobernus 1998). Additionally, in 1972 a 2,000-foot section of Crow Creek just upstream of its confluence with Cull Creek was channelized and covered. This section of altered stream likely impedes migration under most flows (Love 2001). The half-mile concrete culvert under Interstate 580 may also impede fish migration (ACFC & WCD 2002).

General Description

San Lorenzo Creek is about 12.5 miles long with a total watershed area of 48 square miles. The headwaters of San Lorenzo Creek are in the mountains above eastern San Francisco Bay, and it flows through the cities of Hayward and San Leandro, where it then drains into the San Francisco Bay. San Lorenzo Creek has several tributaries including Castro Valley Creek, Chabot Creek, Cull Creek, Crow Creek, Norris Creek, Bolinas Creek, Sulphur Creek, Eden Canyon Creek, Hollis Creek, and Palomares Creek.

Fish Populations

According to the ACFC & WCD, stream habitat throughout the San Lorenzo Creek watershed supports native fish populations (ACFC & WCD 2002). However, salmonid populations are low. Rainbow trout are present in low numbers, probably as a result of stocking in Don Castro Reservoir (ACFC & WCD 2002). San Lorenzo Creek had highly productive steelhead runs up until the 1950s (ACFC & WCD 2002). Steelhead-spawning habitat had become severely limited as early as 1953 (DFG 1953 as cited in ACFC & WCD 2002).

The DFG performed fisheries surveys in 1960 and 1975. In 1960 DFG biologists surveyed major tributaries of San Lorenzo Creek, including Cull, Palomares, Crow and Eden Canyon Creeks. Rainbow trout or steelhead fry were found in Palomares Creek only. In 1975 DFG biologists surveyed San Lorenzo and Crow Creeks and found resident adult rainbow trout in Bolinas Creek, which is a tributary to Crow Creek, but no juveniles were found. DFG biologists concluded that the steelhead run was extirpated due to channel degradation (DFG 1975). Leidy (1984) performed a survey in 1981 in Palomares Creek and no adult or juvenile salmonids were found. In 1998 two rainbow trout were found during surveys by the San Lorenzo Creek Watershed Project, which is administered by the Alameda County Wide Clean Water Program in partnership with the Natural Resources Conservation Service and the Alameda County Resource Conservation District (Greiner Woodward Clyde 1999).

ACFC & WCD (2002) report that there have been numerous reports of adult steelhead and rainbow trout being caught by local anglers or observed in San Lorenzo Creek during wet years from the 1970s to the present. On two occasions, January 2000 and March 2000, ACFC & WCD reported trout in Castro Valley Creek near Knox Street in Hayward. In electroshocking surveys conducted by ACFC & WCD in 2001, three young-of-year rainbow trout were sampled in Crow Creek. Additionally, these surveys gathered adult rainbow trout from Crow Creek and San Lorenzo Creek. Two adult steelhead/rainbow trout were observed in May 2002 in San Lorenzo Creek in the natural section of creek between Foothill Boulevard and 2nd Street in Hayward, according to Emmanuel da Costa, ACFC &WCD, Alameda, California.

Water Quality

Fine sediment loads and episodic poor water quality has limited the numbers and distribution of salmonids in the San Lorenzo watershed. Urbanization has led to increased sediment loading, degraded water quality, altered stream hydrographs, and degraded riparian conditions (ACFC & WCD 2002). Kobernus (1998) found nonpoint source pollutants such as paint, automobile batteries, concrete, soap, and motor oil in San Lorenzo Creek. Fish kills have been reported from chlorine (DFG 1975) and well-drilling sediments (Kobernus 1998). In addition, potentially harmful levels of diazinon have been recorded in the watershed (ACFC & WCD 1997 as cited in ACFC & WCD 2002).

Water temperatures in the reaches upstream of Don Castro Reservoir are generally less than 18 °C. Water temperatures remain relatively warm downstream of Don Castro Dam and the Crow Creek confluence, usually exceeding 21 °C for as much as 25 percent of the time and often exceeding 24 °C. Despite this reach of low-quality habitat, the majority of the watershed has cold water temperatures that can support trout (ACFC & WCD 2002).

Hydrology

Streamflow is highly seasonal and fluctuates sharply in response to winter storms. The USGS maintains several stream gages throughout San Lorenzo Creek watershed. A gage at Don Castro Reservoir recorded peak streamflow from 1981 to 2000, and has recorded daily streamflow and taken water quality samples from 1980 to 2000. A gage in Hayward recorded peak streamflow and daily streamflow from 1940 to 2000 and water quality samples were recorded in 1971. A gage in San Lorenzo recorded peak streamflow from 1968 to 2000, daily streamflow from 1967 to 2000 (Figure E-8), and water quality samples from 1989 to 1993. The USGS also operates a stream gage on Crow Creek, immediately upstream of Crow Canyon Road. This gage recorded peak streamflow from 1998 to 2000, daily

Figure E-8 Mean monthly flows from 1967 to 2000 on San Lorenzo River at San Lorenzo

streamflow from 1997 to 2000, and water quality samples from 1999 to 2000. Cull Creek, which joins Crow Creek immediately downstream of Crow Canyon Road, has a USGS stream gage immediately upstream of Cull Reservoir. This gage has recorded peak streamflow from 1979 to 2000, daily streamflow from 1978 to 2000, and water quality samples from 1979 to 2000. Another USGS station is downstream of the Cull Reservoir Dam. This gage station recorded peak streamflow in 1979, daily streamflow from 1978 to 1979, and water quality samples in 1979 (USGS 2002).

Habitat Quality

Most of the aquatic habitat in the watershed has been greatly altered as a result of urbanization. Fish habitat in San Lorenzo Creek varies significantly from the upper reaches downstream to the San Francisco Bay. Cold water habitat in the upper parts of the watershed would likely support steelhead/rainbow trout in Palomares Creek, Hollis Creek, Eden Canyon Creek, Norris Creek, upper Crow Creek, upper San Lorenzo Creek, Bolinas Creek, Cull Creek, Castro Valley Creek, Chabot Creek, and Sulphur Creek (ACFC & WCD 2002).

However, most of this habitat is isolated upstream of dams and flood control projects. Relatively cool water exists upstream of Don Castro Dam, but high temperatures due to thermal loading exist downstream of the Don Castro Reservoir. San Lorenzo Creek has been highly modified downstream of Foothill Boulevard and does not support fish communities for most of its length. The upper reaches have few deep pools, but good shelter characteristics. The largest and deepest pools are in the lower reaches. There is good riparian vegetation that contributes to instream and overhead cover in the upper reaches (ACFC & WCD 2002). Lower reaches have lower canopy coverage due to widening of the stream channel.

Crow Creek and two of its tributaries, Norris and Bolinas creeks, have the greatest potential for suitable habitat and water temperatures to support rainbow trout (ACFC & WCD 2002). Crow Creek is characterized by a good mixture of pools, glides, and riffles and has relatively deep pools and moderate shelter complexity.

Habitat Data

Habitat data for the San Lorenzo watershed is available in the Fish Habitat and Fish Population Assessment for The San Lorenzo Creek Watershed, Alameda County, California (ACFC & WCD 2002).

Fisheries and Restoration Projects

Michael Love and Associates (2001) assessed the 2,000-foot long culvert on Crow Creek just upstream of its confluence with Cull Creek for fish passage. According to Paul Modrell of ACFC & WCD in Alameda, Alameda County is planning a road-widening project on Crow Canyon Road and the county Environmental Services Division is interested in modifying the culvert to improve fish passage as mitigation.

Alameda County Public Works Agency is preparing a project that will manage sediment accumulations and future sediment inflow at the Don

Castro Reservoir. A pilot project was conducted in 2000, and 15,800 cubic yards of sediment was removed from the delta area. The average annual sediment inflow is 8,600 cubic yards.

The ACFC & WCD and DWR's FPIP are assessing the future of Cull Creek Reservoir and Don Castro Reservoir on San Lorenzo Creek. Management options being assessed range from periodic desilting to removal of the dams.

The ACFC & WCD have been awarded about $140,000 from the Coastal Impact Assessment Program to assess the feasibility of restoring the entire 5-mile USACE flood control channel. This assessment will be done soon. The ACFC & WCD have also received a $350,000 grant from the EPA's 319-h program to restore a reach of Palomares Creek and construct a field science center.

The ACFC & WCD are collaborating with Caltrans to have a drop structure removed or modified to allow fish passage into the Eden Creek subwatershed.

York Creek, Napa County

Potential Impediments to Anadromous Fish Migration

There is one dam and one reservoir on the main stem of York Creek. There is also a second reservoir in the York Creek drainage on an unnamed tributary stream (DFG 1973). York Dam is impassable and is the upstream limit of anadromous fish migration.

General Description

York Creek is a west side tributary to the Napa River at RM 36. It is about 4.5 miles long and drains about 5 square miles. The creek originates in the western hills of the Napa Valley at an elevation of about 1,800 feet. It flows through a narrow canyon, into the Napa Valley, through the town of Saint Helena and enters the Napa River at an elevation of 220 feet. Upstream of the Highway 29 crossing the stream drops in elevation an average of 230 feet per mile. Downstream of the Highway 29 crossing the stream is less steep and only loses 30 feet per mile (DFG 1974).

Fish Populations

York Creek was historically a steelhead stream and today supports a run of steelhead downstream of Saint Helena Upper Dam (York Dam) as well as a population of rainbow trout in the 2 miles of habitat upstream of the dam. The most recent survey of York Creek was done in September 2000. The creek was electrofished from the base of the dam to about a mile downstream to a driveway that leads to the city of Saint Helena water tanks. Juvenile steelhead were found to be abundant and were distributed uniformly. Most of the fish were young-of-year with fewer fish being yearlings and older. In the mile sampled, about 200 fish were seen (DFG 2000a). A May 1986 DFG survey of the creek upstream of York Dam revealed 10 rainbow trout in the 500-foot long reach surveyed (DFG 1986). DFG stream surveys in 1974 and 1975 also report steelhead in York Creek. In 1975 there were estimated to be 20 *Oncorhynchus mykiss* every 100 feet from York Dam upstream to the creek's headwaters (DFG 1975). In 1974, downstream of the dam, young-of-year steelhead trout were estimated to exceed 100 per 100 feet of stream (DFG 1974).

Water Quality

Water quality in York Creek has not been studied extensively. The water temperature is generally cold, but flow may not be adequate downstream of York Dam. Available temperature data include DFG fish surveys in April 1986 and September 2000. Water temperature was 55 °F upstream of the dam in the 1986 survey and 59 °F downstream of the dam in the 2000 survey. There have been several sediment spills in York Creek that resulted in fish kills. Other than these spills there are no documented water quality problems in the creek.

Hydrology

A 1993 DFG stream survey reported flows ranging from 0.1 to 1.4 cfs with an average flow of 0.56 cfs downstream of York Dam on 9 Jul (DFG 1973). In a 1974 DFG stream survey, flow upstream of the dam was estimated at 1.5 cfs. Immediately downstream of the dam, flow was 1.0 cfs and 1,000 feet upstream of Highway 29, the flow was 0.5 cfs. Downstream of Highway 29, flows were intermittent during this 13 Jun survey (DFG 1974). In a 1975 stream survey by DFG the flow at York Dam was determined to be 1.0 cfs on 5 Aug (DFG 1975).

Habitat Quality

The habitat in York Creek can be divided into three reaches: from the confluence with the Napa River upstream to Highway 29, from Highway 29 upstream to York Saint Helena Upper Dam, and from the dam upstream to the headwaters. Downstream of Highway 29 there is little cover, and annual grasses are the predominant vegetation. Upstream the Highway 29 crossing "dense stands of vegetation border the stream" providing adequate cover (DFG 1974). There are also boulders and undercut banks that provide shade and shelter in this reach (DFG 1974). In this area, the riffle to pool ratio is 1:1, and the substrate is 60 percent gravel (DFG 1973). Upstream of the dam there is high quality steelhead habitat. The riffle-to-pool ratio was 3:1 and there was 100 percent cover over 90 percent of the pools in this upper reach in a 1975 DFG survey. About 30-40 percent of the streambed upstream of York Dam was considered good spawning habitat because of the good gravel substrate. Significant logjams were observed in the creek during a 1975 DFG survey. The status of those jams is unknown. The most recent survey of the creek was done on 27 Sep 2000. A large number of steelhead were observed downstream of the dam at this time. Water temperature was 59 °F and "the overhanging riparian tree vegetation provided about 75 percent shade cover" (DFG 2000b) over the surveyed portion of the creek. There was also good shelter and, according to the DFG survey by Fishery Biologist Bill Cox, the area downstream of the dam "provided habitat with a very high potential to support steelhead" (Cox 2000). Gravel was limited, but present, downstream of the dam (DFG 2000b).

Habitat Data

There are three published DFG stream surveys of York Creek available in the Region III office. One was done in 1973 from the mouth of the creek up to York Dam. The second one, done in 1974, covered the same reach. The third survey, done in 1975, covered the creek from the dam upstream to its headwaters. These surveys contain flow and temperature data as well as information about what fish were present and descriptions of the habitat at the time of the surveys. There is no flow gage on the creek.

Fishery and Restoration Projects

As a result of a complaint filed by the DFG, the city of Saint Helena agreed to remove York Dam. The city obtained the required permit from the USACE. The estimated cost of removal was $500,000 (DFG 2000a). DWR's FPIP began the initial environmental and engineering tasks for removal of the dam. The dam removal project has been turned over to USACE by the city of Saint Helena for further study and evaluations for future removal efforts.

Modifications on the diversion dam, owned by the city of Saint Helena, were completed in 2004. This modification involved removal of the concrete masonry diversion structure. This will enable juvenile steelhead easier migration and increase delivery of spawning sized gravel to lower York Creek and Napa River. Approximately 2.5 miles of high-quality habitat is now accessible.

Fish Passage Activities in the Bay Area

Alameda Creek – Alameda County

A flood control drop structure owned by the ACFC & WCD in lower Alameda Creek has blocked steelhead trout from spawning and rearing habitat in Sunol Regional Wilderness and other areas of the Upper Alameda Creek watershed since the 1960s. There are numerous other structures in the creek that act as barriers or partial barriers to fish passage. These include three inflatable dams and water diversion structures in the lower creek's flood control channel, owned by the Alameda County Water District; 6-foot-high Niles Dam and 12-foot-high Sunol Dam in Niles Canyon owned by the SFPUC, and a PG&E gas-pipeline crossing. Table E-1 is a partial list of fish passage barriers along Alameda Creek and its watershed. In order to restore a steelhead fishery to Alameda Creek, modification for fish passage and protection at these facilities is being explored, as well as modification of county-owned culverts and a drop structure in Stonybrook Creek and Arroyo Mocho, both tributaries to Alameda Creek.

Table E-1 Partial list of barriers to fish passage in the Alameda Creek watershed

Community and agency support for restoring migratory fish runs has been building. In February 2000, the Alameda Creek Fisheries Restoration Workgroup released a report that concluded it would be feasible to restore a viable steelhead fishery to Alameda Creek. The study outlined the changes necessary to begin restoration and showed there is suitable habitat to support a self-sustaining population of steelhead trout. The report also identified items that required additional study, including the determination of instream-flow requirements to support a steelhead fishery, and the source of water for these flow requirements.

Photo E-1 Lower Alameda Creek—inflatable dam

In addition, considerable media attention and new environmental regulations concerning anadromous fish motivated management agencies to participate in the restoration. Participants include Alameda Creek Alliance, ACFC & WCD, Alameda County Water District, the SFPUC, PG&E, DFG, DWR, NOAA Fisheries, the EBRPD, California State Coastal Conservancy, USACE, city of Fremont, Zone 7 Water Agency, Math/Science Nucleus, and Alameda County Supervisor Scott Haggerty.

Photo E-2 Lower Alameda Creek—BART Weir/Paul Salop photo

Among the projects being developed, ACFC & WCD and the Alameda County Water District are working closely with USACE to pursue 1,135 program funds for construction of fish passage improvements in the lower, channelized portion of the creek. A conceptual plan prepared by CH2MHill proposes three fish ladders and seven fish screens in the lower flood control channel. The estimated costs of the proposed fish facilities at the lower barriers, including engineering, mitigation for environmental impacts, construction inspection, and contract administration are $1.5 million at the lower inflatable dam, $2.9 million at the BART weir and middle inflatable dam, and $1.4 million at the upper inflatable dam (photos E-1 and E-2). The estimated cost of the seven fish screens is $4.1 million. The total estimated cost of the proposed projects is $9.9 million. If funds are procured construction is expected in 2007.

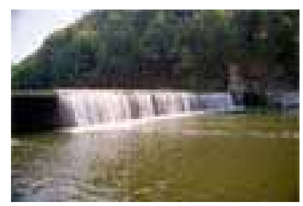

Photo E-3 Alameda Creek—Sunol Dam/SFPUC photo

In addition, SFPUC announced in 2005 it will remove two dams, Sunol Dam and Niles Dam, both in the Niles Canyon reach of Alameda Creek (photos E-3 and E-4). Because of sediment behind Sunol Dam, an environmental assessment was needed. PG&E is also investigating alternatives to improve fish passage at its gas-pipeline crossing. PG&E would place a series of additional articulated concrete mats with backfill to regrade the site, construct a series of step pools in the middle of the existing structure, and build a traditional fish ladder.

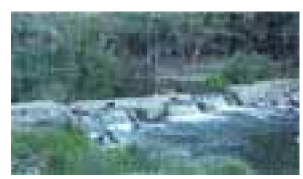

Photo E-4 Alameda Creek—Niles Dam/SFPUC photo

In August 2001, EBRPD removed two small swim dams in Sunol Wilderness at a cost of $25,000. DWR shared the cost of removing the swim dams (Photo E-5).

Photo E-5 Alameda Creek—East Bay Regional Parks District swim dam prior to removal in 2001/Jeff Miller photo

Los Trancos Creek – San Mateo and Santa Clara Counties

Los Trancos Creek, a tributary to San Francisquito Creek, sustains a steelhead trout population that has historically been naturally reproducing, primarily in the 2.5 miles of the creek downstream of Stanford University's Felt Lake Diversion Dam. A fishway built at the Felt Lake Diversion Dam in 1995 provided access to an additional 3.5 miles of the creek. DFG has been working with Stanford University to implement improvements to the fishway. However, three structures upstream of the fishway significantly impede upstream steelhead migration to the headwaters of Los Trancos Creek (Table E-2). The first structure upstream of the fishway is an obsolete flashboard swim dam, Los Trancos Flashboard Dam, which presents the most severe steelhead migration barrier in upper Los Trancos Creek (Photo E-6). Two double box culverts also restrict adult steelhead migration under certain flow conditions.

Table E-2 Partial list of barriers to fish passage in Los Trancos Creek – San Mateo and Santa Clara counties

Photo E-6 Los Trancos Creek—Los Trancos Flashboard Dam/ Kevin Murray, S.F. Creek JPA photo

In March 2002, the San Francisquito Creek JPA and San Francisquito Watershed Council submitted a grant proposal to the American Rivers/NOAA Community-based Restoration Program Partnership to fund a project to remove the old Los Trancos/Agosti Dam. American Rivers and NOAA approved the request of $49,000 for the modification of the structure, and DWR assisted the San Francisquito Watershed Council in planning the project through early 2004. The modification of the Los Trancos/Agosti Dam could occur as early as 2005.

For more information, contact:
Kevin Murray, San Francisquito Creek Joint Powers Authority
(650) 251-8831; e-mail: kmurray@menlopark.org

Phil Chang, San Francisquito Creek Steelhead Technical Task Force
(650) 962-9867 ext. 304;
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Erika Cleugh, DFG
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Drop Structure, Marsh Creek – Contra Costa County

Marsh Creek is a tributary of the San Joaquin River in Contra Costa County. The lower Marsh Creek drop structure, in the city of Brentwood, is a grade-control structure about 4 miles upstream from the mouth of Marsh Creek at Big Break in the western Delta (Table E-3 and Photo E-7). Recent repeated observations of adult Chinook salmon have increased interest in this fish barrier. DFG surveys by Darrell Slotten in 1995-1997 and by Erica Cleugh in 2002 found juvenile (60-80 mm) Chinook rearing in lower Marsh Creek.

Table E-3 Partial list of barriers to fish passage in Marsh Creek - Contra Costa County

Modification or removal of the drop structure will open up 4 miles of Marsh Creek, of which approximately 3 miles have shaded riparian vegetation and suitable spawning gravel.

Photo E-7 Marsh Creek—drop structure/NH photo

Marsh Creek Dam is about 7 miles upstream of the drop-structure and is a complete barrier to anadromous fish migration. Immediately downstream of the dam a riparian corridor extends for about three miles along Marsh Creek. In a 2004 report, Levine and Stewart state that Marsh Creek, upstream of the lowest fish barrier, has suitable gravel quality, quantity, and vegetative cover to support Chinook spawning. This area does not appear to have any over-summering habitat available for steelhead.

In 2004, NHI and American Rivers secured approximately $22,000 from American Rivers/NOAA and $44,000 from the California Coastal Conservancy to complete the engineering design, construction documents, and permitting for the fish passage project on Marsh Creek. The design and permitting work will be complete by the summer of 2005. In addition, CALFED has awarded $120,000 to NHI for a watershed assessment, water quality monitoring program, and identification of potential restoration projects. The California Coastal Conservancy awarded NHI $30,000 for design of a creek corridor protection plan in Brentwood. Additionally, the City of Brentwood has received $1.2 million from DWR and California State Parks to purchase and restore 5 to 11 acres at the confluence of Marsh, Sand, and Deer creeks. CALFED has granted funds for tidal marsh restoration of about 1,000 acres at the mouth of Marsh Creek. These funds also include water quality monitoring, public outreach and education.

San Francisquito Creek – San Mateo County and Santa Clara County

DFG considers the 45-square-mile San Francisquito Creek watershed to be the best remaining steelhead fishery in the southern San Francisco Bay Area (Table E-4). Searsville Dam owned by Stanford University, blocks access to upstream reaches in the Corte Madera Creek watershed, but resident rainbow trout flourish upstream of the dam. Today, about 66 percent of the former spawning waters are available to steelhead (Laura Kilgour 2003 Sep 4 pers comm).

Table E-4 Partial list of barriers to fish passage in San Francisquito Creek – San Mateo and Santa Clara counties

The watershed is listed as impaired by siltation and the urban pesticide diazinon (USEPA 1998). Concern has been expressed about reduction of water to riparian zones in the San Francisquito watershed due to surface water diversion and pumping of shallow groundwater from wells located along the creek banks (CRWQCB 2003 AND SCBWMI 2003).

Photo E-8 San Francisquito Creek—Searsville Dam/ Matt Stoecker photo

Stanford University owns the 68-foot-high dam that was built in 1892 (Photo E-8). It is on Corte Madera Creek in the Jasper Ridge Biological Preserve). The creek supports one of the last runs of wild steelhead in the southern San Francisco Bay Area. Searsville Dam blocks the migratory steelhead from reaching abundant aquatic habitat found upstream in several headwater streams including Corte Madera Creek, one of San Francisquito Creek's largest tributaries. The amount of critical spawning and rearing habitat available to steelhead would substantially increase with the removal of Searsville Dam.

The present level of sediment deposition in Searsville Lake is approximately 12 feet below the elevation of the Searsville Dam spillway. Accumulation of an estimated 900,000 to 1.6 million cubic yards of sediment behind the dam has reduced the water storage capacity of the reservoir by about 90 percent. Stanford officials estimate the reservoir may completely fill with sediment in the next 20 years if nothing is done. The dam is an obsolete water diversion source and provides no electricity or flood control. Continued accumulation of sediment within the reservoir is causing serious flooding problems upstream at Family Farm Road.

For more information on Searsville study go to http://www.cityofpaloalto.org/cityagenda/publish/jpa-meetings/1836.pdf.

Many of those in the watershed, including Stanford University, agree that removing Searsville Dam should be considered. However, there are questions about how it could be removed and the effects on the watershed. Stanford funded the Searsville Lake Sediment Impact Study—completed in 2001—to determine if the increase in sediment resulting from the lowering or removal of Searsville Dam is tolerable in the downstream environment. The determination was that the increase in sediment would not be tolerable. This determination requires sediment management to insure that communities downstream of the dam do not incur a higher risk of flooding. The JPA staff will be working closely with Stanford and other watershed stakeholders as discussions for long-term management options for Searsville progress.

The San Francisquito Creek Steelhead Technical Task Force formed to help implement projects to improve habitat conditions for the creek's steelhead. It is working with the San Francisquito Creek Watershed Council Steering Committee, a well established watershed group formed in 1993. The San Francisquito Creek JPA is an agency empowered to protect and maintain San Francisquito Creek and its 45 square-mile watershed. Stanford University and the Watershed Council serve as associate members. The JPA has acknowledged that the removal of Searsville Dam is an option worth investigating. In addition, the California Water Service Co., owners of the Bear Gulch water diversion farther upstream on Bear Gulch (a tributary of Bear Creek), is considering options for improvements at their dam in the near future.

For more information, contact Erika Cleugh, DFG (831) 649-7153; e-mail: ecleugh@dfg.ca.gov

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San Lorenzo Creek – Alameda County

Stream habitat throughout the San Lorenzo Creek watershed supports native fish populations, and San Lorenzo Creek had highly productive steelhead runs up until the 1950s. The ACFC & WCD reports that there have been numerous adult steelhead and rainbow trout being caught by local anglers or observed in San Lorenzo Creek during wet years from the 1970s to the present.

Table E-5 Partial list of barriers to fish passage in San Lorenzo Creek - Alameda County

The majority of suitable habitat is now isolated upstream of dams and flood control projects that have created potential impediments to fish passage, and have led to fragmentation and isolation of aquatic habitats (Table E-5). San Lorenzo Creek has been highly modified downstream of Foothill Boulevard and does not support fish communities for most of its length. Palomares and Cull creeks, tributaries to San Lorenzo Creek, are not accessible to anadromous steelhead due to the presence of Don Castro Dam (Photo E-9), completed in 1965, and Cull Canyon Dam, completed in 1962 (Photo E-10). Both of these dams are impediments to fish migration, and both reservoirs provide habitat for introduced warm water species, such as bass, that prey on juvenile salmonids. Relatively cool water exists upstream of Cull Canyon and Don Castro Dams, but high temperatures due to thermal loading exist downstream of both Cull Canyon Reservoir and Don Castro Reservoir.

Photo E-9 Palomares Creek—Don Castro spillway /ACPWA photo

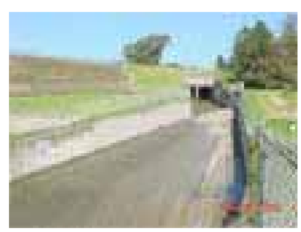

Photo E-10 Cull Creek—Cull Canyon spillway/ACPWA photo

Both reservoirs are nearly filled with sediment. Upstream land use practices and highly erodible terrain contribute to the severe sediment accumulation problem at the reservoirs. In a 2000 pilot dredging effort, 11,300 cubic yards of sediment were removed from the delta area of Cull Canyon Reservoir. The current average annual sediment inflow is 13,600 cubic yards. At Don Castro Reservoir, 15,800 cubic yards of sediment were removed from the delta area in a similar pilot test in 2000. The current average annual sediment inflow is 8,600 cubic yards.

The ACFC & WCD have undertaken an evaluation of sediment management options at the reservoirs as part of assessing the future of the two reservoirs.

Sediment management studies completed in June 2003 ranged from no action, allowing the reservoir to fill in with sediment, periodic desilting, total removal of the dams, to dry-dams for flood storage. Downstream flood capacity issues are currently being addressed. Engineering feasibility studies with the option of flood storage capabilities will be completed in late 2005. Potential concerns being addressed by the project include the desire of homeowners in view of the reservoir to maintain the lakes, how to deal with sediment accumulation, and how to provide fish passage to upstream habitat.

For more information, contact P.E. Baker, County of Alameda Public Works Agency (510) 670-5776

Emmanuel da Costa, Alameda County Flood Control and Water Conservation District (510) 670-6479; e-mail: mannyd@acpwa.org

York Creek – Napa County

Saint Helena Upper Dam (also referred to as York Creek Dam) is identified as an impediment to fish passage (Table E-6). The diversion structure downstream was modified in 2004 to provide passage for adult and juvenile steelhead. York Creek Dam, forming Upper Reservoir on York Creek, is a 50-foot-high earthen dam built around the turn of the 19^{th} century (Photo E-11). The dam blocks steelhead from approximately 2 miles of habitat found upstream. Little is known about the history of the dam other than it was originally built to provide a water source for private landowners. The city of Saint Helena purchased the dam and maintained it for many years to impound water for release downstream to the diversion structure, which conveys water to Lower Reservoir. Lower Reservoir is still used by the city as a source of irrigation water. Since the city has owned York Creek Dam there have been four silt discharges from the dam into York Creek in 1965, 1973, 1975, and 1992. After the 1992 discharge, DFG filed a complaint with the Napa County District Attorney. As a result, the city agreed to a settlement in 1993 that mandated the removal of York Creek Dam. Since 1993, Upper Reservoir has not been used by the city as a water source, but the reservoir has been dredged by the city and it functions as a detention basin.

Table E-6 Partial list of barriers to fish passage in York Creek – Napa County

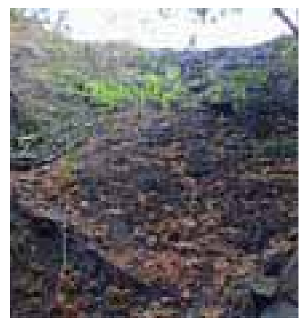

Photo E-11 York Creek—dam, downstream face/DWR photo

Major modifications of the diversion structure were completed in 2004. The modifications involved removal of the concrete masonry diversion structure, creation of cascading steps with resting pools of sufficient depth for steelhead, bank stabilization, and native plant generation. A proposed infiltration gallery designed to prevent juvenile salmonid entrainment may be placed in the streambed after a one- or two-year trial period without any water diversion structure. Approximately 2.5 miles of high-quality habitat is now accessible.

For more information, contact Jonathon Goldman, City of Saint Helena.
(707) 968-2658; e-mail: JonathonG@ci.st-helena.ca.us

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The city of Saint Helena has conducted engineering and fishery studies to investigate several issues:

- Whether the creek provides conditions for fish migration downstream and upstream of the dam
- Whether the topography underlying the dam would act as a barrier to fish migration
- Engineering aspects of using erosion control materials for removal of the dam and sediment

Several years ago the city estimated the cost of removing York Creek Dam at $500,000. The FPIP assisted the city in engineering aspects and pursuing the environmental documentation to remove York Creek Dam until 2003. A Memorandum of Agreement (MOA) between the city and DWR was developed, outlining DWR's role in providing planning, design, and permit services to the city for the project. Initially, on behalf of the city of Saint Helena, DWR coordinated with DFG, the NMFS, the Natural Resources Conservation Service, USACE, and the US Fish and Wildlife Service on aspects of the project. The project to remove York Creek Dam is being considered for funding under the USACE Continuing Authorities Program and, therefore, may be carried out by USACE.

Appendix E Bay Area and Delta Watersheds Outside the FPIP Geographic Scope

Figures

Photographs

Tables

Figure E-1 2003 Fish Passage Improvement Program priority waterways and known structures of the Bay Area and Delta

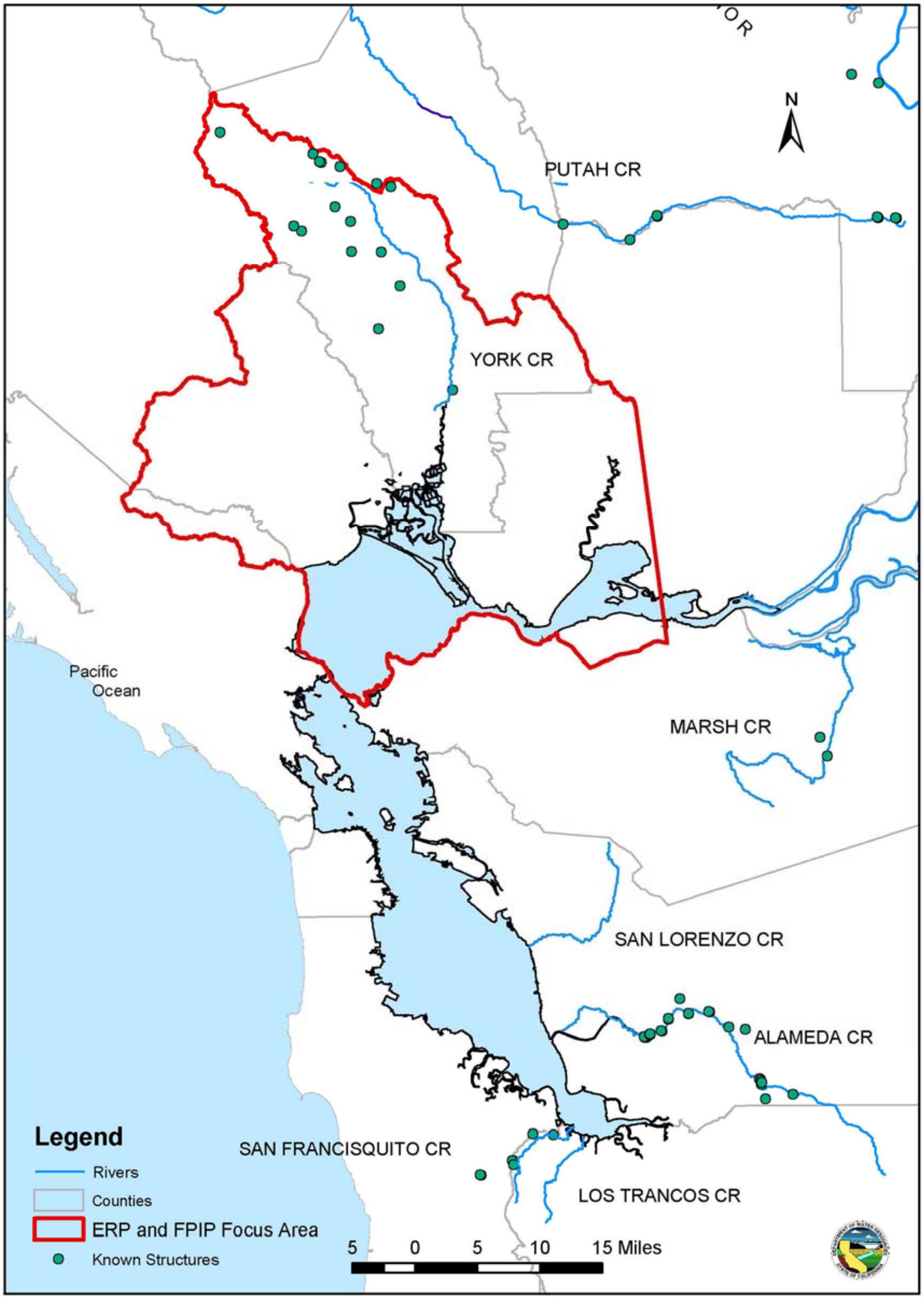
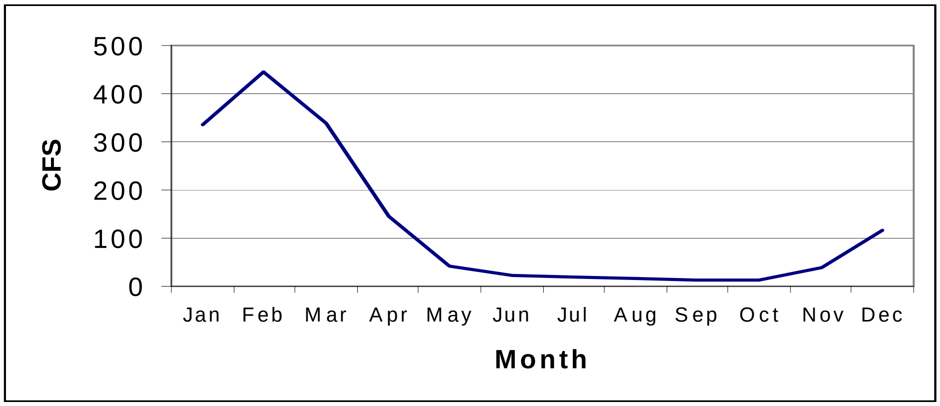
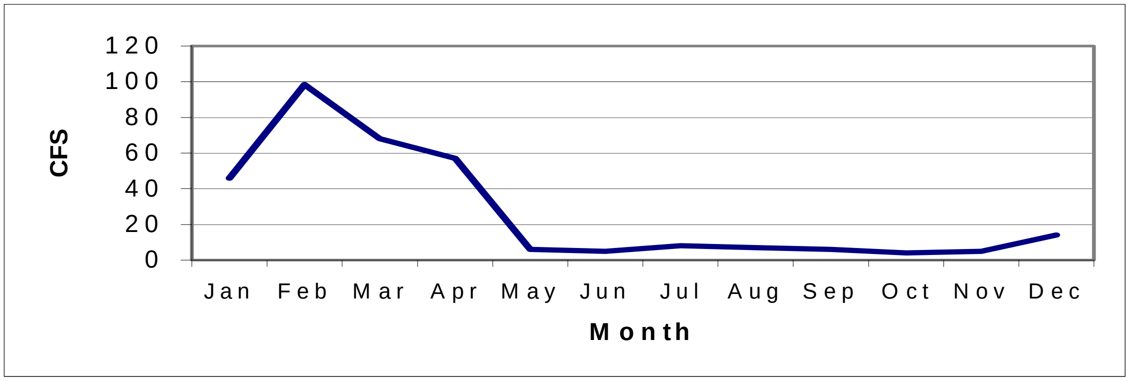


Figure E-2 Mean monthly flows from 1891 to 2000 on Alameda Creek at Niles



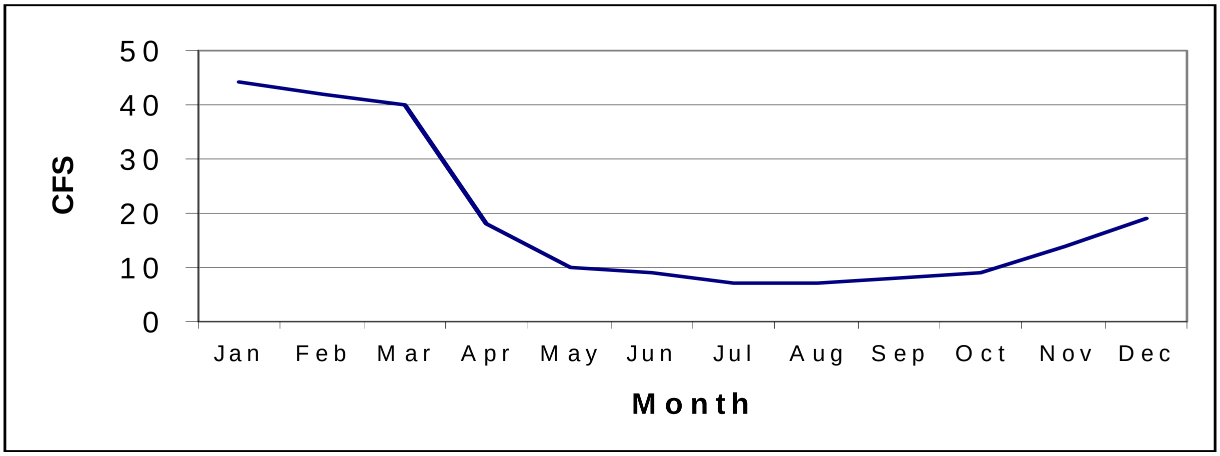
Note: USGS gage number 11179000 (USGS 2002)

Figure E-3 Mean monthly flows from 1957 to 1985 on Arroyo Valle at Pleasanton



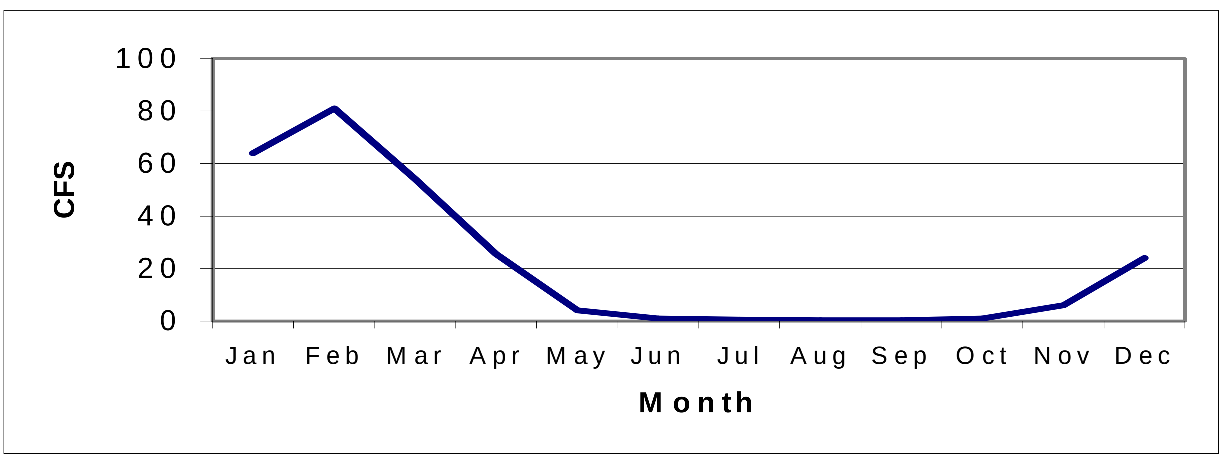
Note: USGS gage number 11176600 (USGS 2002)

Figure E-4 Mean monthly flows from 1962 to 1985 on Arroyo Mocho at Pleasanton



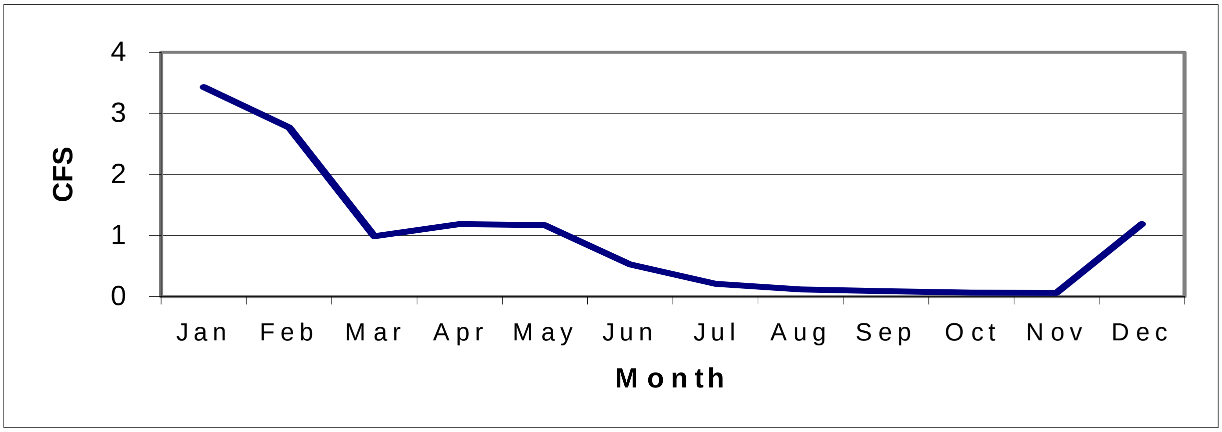
Note: USGS gage number 11176200 (USGS 2002)

Figure E-5 Mean monthly flows from 1930 to 2000 on San Francisquito Creek at Stanford University



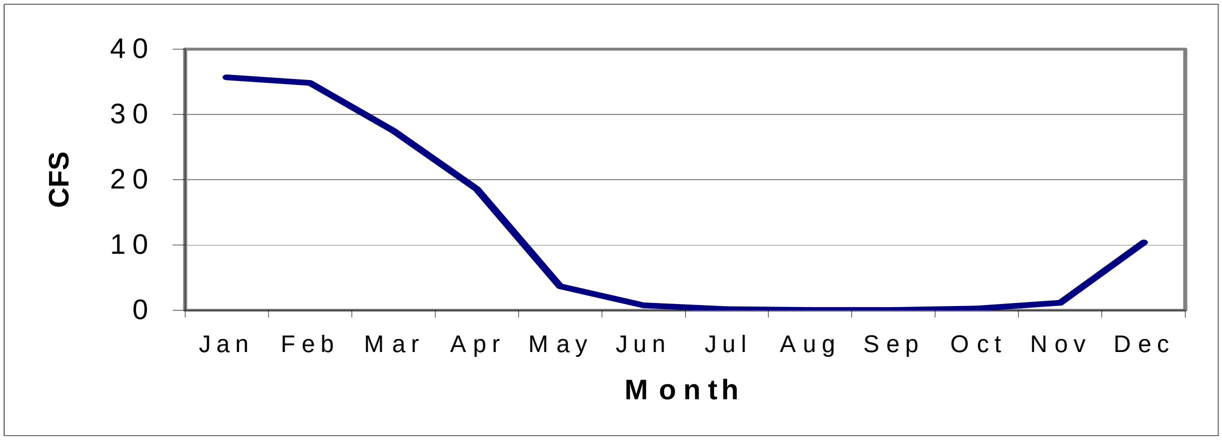
Note: USGS gage number 11164500 (USGS 2002)

Figure E-6 Mean monthly flows from 1930 to 1941 on Los Trancos Creek near Stanford University



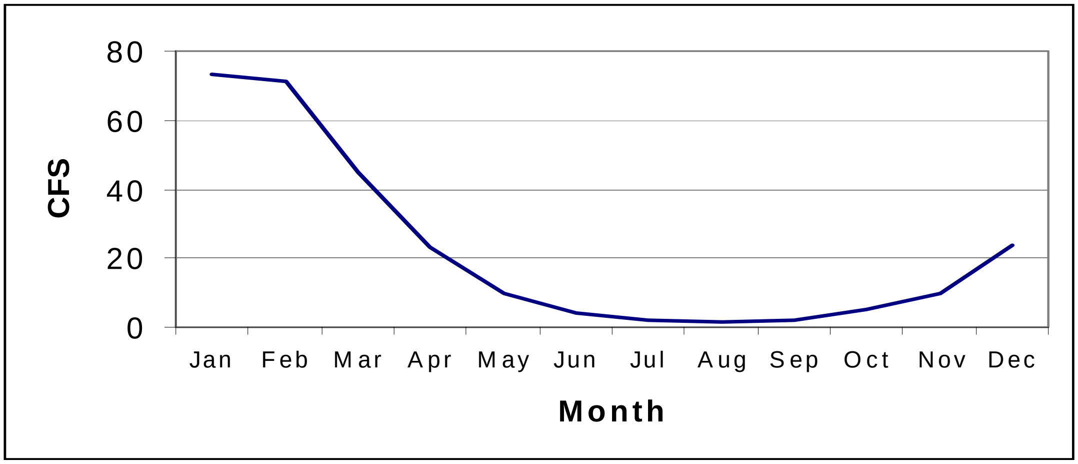
Note: USGS gage number 11163000 (USGS 2002)

Figure E-7 Mean monthly flows from 1953 to 1983 on Marsh Creek near Byron



Note USGS gage number 11337500 (USGS 2002)

Figure E-8 Mean monthly flows from 1967 to 2000 on San Lorenzo River at San Lorenzo



Note: USGS gage number 11181040 (USGS 2002).

Photo E-1 Lower Alameda Creek—inflatable dam

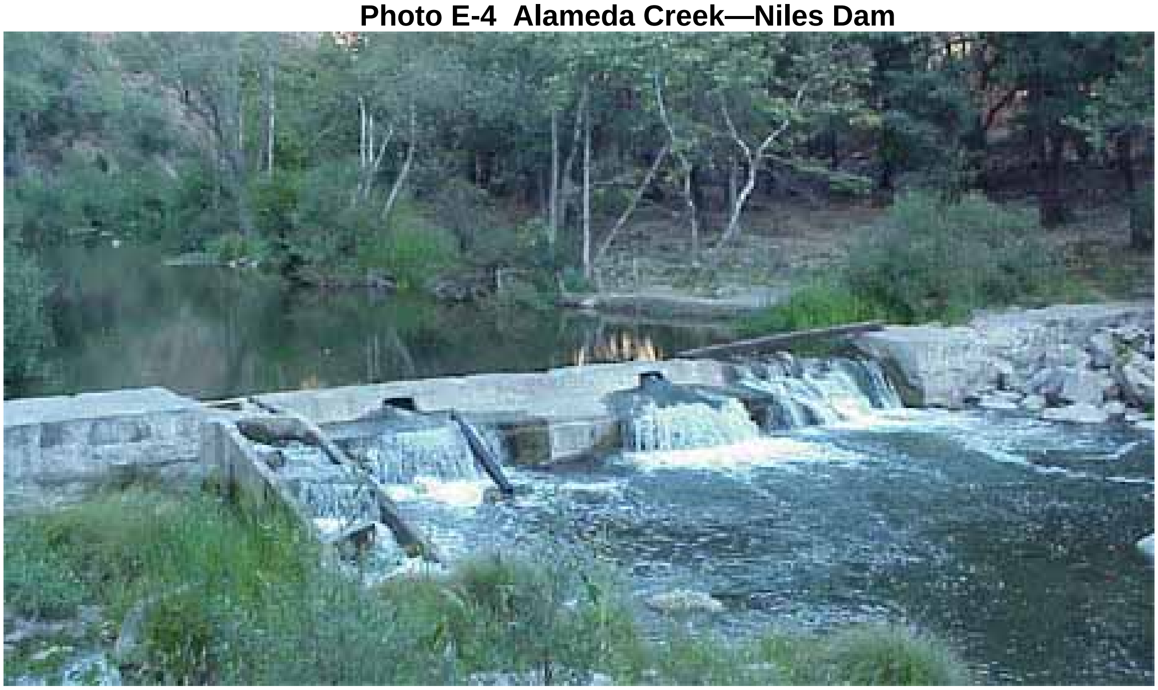
Photo E-2 Lower Alameda Creek—Bart Weir

Paul Salop photo

Photo E-3 Alameda Creek—Sunol Dam

SFPUC photo

Photo E-4 Alameda Creek—Niles Dam



SFPUC photo

Photo E-5 Alameda Creek—East Bay Regional Park District swim dam prior to removal in 2001

Jeff Miller photo

Photo E-6 Los Trancos Creek—Old Los Trancos Flashboard Dam

Kevin Murray, SF Creek JPA photo

Photo E-7 Marsh Creek—drop structure

NH photo

Photo E-8 San Francisquito Creek—Searsville Dam

Matt Stoecker photo

Photo E-9 Palomares Creek—Don Castro spillway

ACPWA photo

Photo E-10 Cull Creek—Cull Canyon spillway

ACPWA photo

Photo E-11 York Creek—York Creek Dam, downstream face

DWR photo

Table E-1 Partial list of barriers to fish passage in the Alameda Creek watershed

Structure name	RM	Height (ft)	Width (ft)	Description	Fish passage facility	Passage?
Alameda Creek						
BART weir	9.5	12		Concrete sloping drop structure	None	No
Middle Inflatable Dam	9.6	13	276	Seasonal, inflatable rubber dam	None	Passable when deflated
Upper Inflatable Dam	10.5	13	375	Seasonal, inflatable rubber dam	None	Passable when deflated
Niles Dam	11.9	6		Dam	Nonfunctional ladder	Observed passable at 233-397 cfs
Sunol Dam	16.3	22		Dam	Nonfunctional ladder	No
Natural Gas Pipeline	18.6	10		Sloping articulated concrete mat protecting 36 ft.	None	Barrier at all but the highest flows
Weir	19.7	6		Rock gabions 6 ft. high and 10 ft. deep	None	Passable at modest flows
Alameda Creek Diversion Dam	27.6			Dam diverts water to Calaveras Reservoir	None	No
Arroyo Mocho						
Drop structure	0	2-3		Sloping structure and concrete apron	None	Structure removed
Drop structure	7.5	3-4		Vertical structure stabilizing a railroad bridge	Potential passage in a side channel.	No passage at 10-12 cfs. May be passable at higher flows.
Road crossing	12	Sloping 20 ft. section		Concrete apron, 20-ft. steeply sloping section plus 20-ft. low gradient section	None	Structure removed

Table E-2 Partial list of barriers to fish passage in Los Trancos Creek – San Mateo and Santa Clara counties

Structure name	RM	Height (ft)	Width (ft)	Description	Fish passage facility	Passage?
Los Trancos Flashboard Dam	3	6		Flashboard dam with concrete-lined basin	Dam is notched	Passable at intermediate and high flows
Felt Lake Diversion Dam	2.5			Dam	Ladder	Operating
Culvert				Double Box Culvert		Low flow barrier
Culvert				Double Box Culvert		Low flow barrier

Table E-3 Partial list of barriers to fish passage in Marsh Creek - Contra Costa County

Structure name	RM	Height (ft)	Width (ft)	Description	Fish passage facility	Passage?
Marsh Creek drop-structure		5	40	Concrete drop-structure	None	Maybe under extreme high flows

Table E-4 Partial list of barriers to fish passage in San Francisquito Creek – San Mateo and Santa Clara Counties

Structure name	RM	Height (ft)	Width (ft)	Description	Fish passage facility	Passage?
Stanford golf cart crossing	6.96			42-inch iron and 24-inch asbestos cement pipe culvert under a road	None	Removed in summer 2004
Bonde Bridge apron	4.76			Bridge apron/culvert	None	Pending funding, landowner permission, & permitting
Unnamed weir	7.77			Dam/weir	None	Needs evaluation
Lake Lagunita Diversion Dam	8.01			Dam/weir	None	Needs evaluation

Table E-5 Partial list of barriers to fish passage in San Lorenzo Creek - Alameda County

Structure name	RM	Height (ft.)	Width (ft.)	Description	Fish passage facility	Passage?
Don Castro Dam				Dam	None	No
Cull Canyon Dam				Dam	None	No
Zone 2, Line B Lorenzo C Fld Control Channel				3.8 Mile long Concrete Flood Control Channel	None	A barrier

Table E-6 Partial list of barriers to fish passage in York Creek – Napa County

Structure name	RM	Height (ft)	Width (ft)	Description	Fish passage facility	Passage?
Diversion structure	2	5		Proposed infiltration gallery	Cascading steps with resting pools	Passable at all flows
York Dam	2.5	50		Earthen dam	None	No

Appendix F California Department of Fish and Game Administrative Reports Used to Compile the GrandTab Table

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Appendix G Literature Cited in Chapter 3 Existing Habitat Conditions and Status of Fish Populations

This appendix includes literature cited in Appendix E Bay Area and Delta Watersheds outside the FPIP Geographic Scope

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Appendix H Contributors to the Barriers Database

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Report	EA Engineering, Science, and Technology		Gravel Studies Report: 1987-1989, FERC Report 96-8, Supplement to 1992 FERC Report Appendix 8.	Lafayette, CA 94549, Turlock and Modesto Irrigation Districts	1997
Letter	Lanferman	P.E.	Letter to Mr. Willard Greenwald, Regional Manager, Region 3, DFG May 1, 1972	Zone Number 7 of the Alameda County Flood Control and Water Conservation District	1972
Report	EA Engineering, Science, and Technology		Redd Excavation Report, FERC Report 96-7, Supplement to 1992 FERC Report Appendix 7.	Lafayette, CA 94549, Turlock and Modesto Irrigation Districts	1997
Report	Strohschein	W. E.	Del Valle Reservoir, Alameda County: Lumnological Data	Department of Fish and Game, Region 3 File	1973
Report	EA Engineering, Science and Technology		Meeting Flow Objectives for the San Joaquin River Agreement 1999-2010, Environmental Impact Statement and Environmental Impact Report.	Sacramento, CA, US Department of the Interior, Bureau of Reclamation	1998
Survey	Gray	F.	Del Valle Creek, Alameda County. Fish Population Sampling.	Department of Fish and Game, Region 3 File	1986
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Report	Faulkenberry	K.J.	Flow Frequency Analysis: Merced, Stanislaus, and Tuolumne Rivers.	Fresno, California Department of Water Resources, San Joaquin District	1996
Survey	Department of Fish and Game		Stream Survey, Arroyo Del Valle	Department of Fish and Game, Region 3 File	1957
Report	Ford	T.	1996 FERC Report, Lower Tuolumne River.	Turlock, CA, Turlock and Modesto Irrigation Districts	1997
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Report	Ford	T.	Tuolumne River Salmon Spawning Summary, FERC Report 96-1, Supplement to 1992 FERC Report Appendix 3.	Turlock, CA, Turlock and Modesto Irrigation Districts	1997
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Survey	Department of Fish and Game		Calaveras Reservoir Limnological Data	Department of Fish and Game Files, Region 3	1965
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Report	Jones & Stokes Associates, Inc.		Analysis of Physical Processes and Riparian Habitat Potential of the San Joaquin River, Friant Dam to the Merced River	Sacramento, For San Joaquin River Riparian Habitat Restoration Program	1998
Report	Ford	T.	1998 FERC 2299 Report Lower Tuolumne River	Turlock and Modesto Irrigation Districts	1999
Survey	Gray	F	Calaveras Creek, Tributary to Alameda Creek. Fish Population Sampling	Department of Fish and Game Files, Region 3	1988
Report	Ford, T. and EA Engineering, Science & Technology		1998 Juvenile Salmon Report and Summary Update, 1998 Lower Tuolumne River Annual Report	Turlock and Modesto Irrigation Districts	1999
Survey	Fisheries Management	DFG	Calaveras Reservoir, Alameda County; Gill Net Results, June 12-13, 1773	Department of Fish and Game Files, Region 3	1973
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Report	Ford, T. and EA Engineering, Science & Technology		Spawning Survey Summary Update, 1998 Lower Tuolumne River Annual Report	Turlock and Modesto Irrigation Districts	1999
Survey	Stohschein	W.E.	Calaveras Reservoir, Santa Clara County: Gill Netting Results, October 29-30, 1973	Department of Fish and Game Files, Region 3	1973

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Report	Ford, T. and S. Kirihara		1999 Juvenile Salmon Report and Summary Update, FERC Report 99-4.	Turlock, CA, Turlock and Modesto Irrigation Districts EA Engineering, Science, and Technology	2000
Web site	Horii	R.	Alameda Creek Regional Trail	http://pages.prodigy.net/rhorii/alamdack.htm	2001
Report	Ford, T. and S. Kirihara		Spawning Survey Summary Update, FERC Report 99-3	Turlock, CA, Turlock and Modesto Irrigation Districts EA Engineering, Science, and Technology	2000
Survey	DWR		Barrier survey of the Calaveras River	Barrier survey of the Calaveras River	2001
Report	Ford, T. and S. Kirihara		Summary report of salvage and losses of Chinook salmon at water export facilities near Tracy, CA during January to June from 1993-1999, FERC Report 99-6	Turlock, CA, Tuolumne River Technical Advisory Committee, Turlock and Modesto Irrigation Districts, and EA Engineering, Science, and Technology	2000
Report	Hallock, R. J. and W. F. V. Woert		A Survey of Anadromous Fish Losses in Irrigation Diversions for the Sacramento and San Joaquin Rivers	California Department of Fish and Game 45(4): 227-296	1959
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Report			Mokelumne River Chinook Salmon & Steelhead Monitoring Program 1993-1994		1994
Personal Comm.	Warner, Phil, DFG.		Phil Warner, DFG, Region 1		
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Map	Stockton-East Water District		Stockton-East Water District Barrier Map		
Personal Comm.	Ward, Paul, DFG, Chico		Paul Ward, DFG, Chico		
Web site	California Rivers Assessment		California Rivers Assessment Interactive Web Database	http://www.ice.ucdavis.edu/newcara/ search by river basin	2000

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Personal Comm.	Icanberry, John, USFWS		John Icanberry, USFWS		
Survey	US Bureau of Reclamation		San Joaquin River Aerial Photos	Series of aerial photos from Old River (roughly Mossdale) to Friant Dam	1993

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Report	Kratzer	C.R.	Transport of Sediment-Bound Organochlorine Pesticides to the San Joaquin River, California	Sacramento, CA. US Geological Survey, National Water-Quality Assessment Program. Open-File Report 97-655.	1998
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Report	McBain & Trush		Tuolumne River Corridor Restoration Plan, Stanislaus County, CA.	Arcata, CA. Tuolumne River Technical Advisory Committee: 147	1998
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Report	Vick	J.C.V.	Habitat Rehabilitation in the Lower Merced River: A Geomorphological Perspective	Aggregate mining impacts	1995
Report	McBain & Trush and Stillwater Sciences		Tuolumne River Restoration Project Monitoring: Special Run Pools 9/10 and Gravel Mining Reach 7/11, FERC Report 99-10	Arcata, CA and Berkeley, CA. Tuolumne River Technical Advisory Committee, US Fish and Wildlife Service Anadromous Fish Restoration Program, and CALFED Ecosystem Restoration Program.	1999
Report	McBain & Trush and Stillwater Sciences		Tuolumne River Restoration Project Monitoring: Special Run Pools 9/10, 7/11 Mining Reach, and Ruddy Mining Reach, FERC Report 99-11	Arcata, CA 95521 and Berkeley, CA 94704, Tuolumne River Technical Advisory Committee, US Fish and Wildlife Service Anadromous Fish Restoration Program, and CALFED Ecosystem Restoration Program	2000
Report	McEwan, D., and Jackson, T.A.		Steelhead Restoration and Management Plan for California.	Sacramento, State of California, The Resources Agency, Department of Fish and Game	
Report	McFarland, M. and D. Weinrich		Juvenile Chinook Salmon Use of Nearshore Habitats on the San Joaquin River, California	August 1987. US Fish and Wildlife Service, Division of Ecological Services, Sacramento, CA. Prepared for the US Army Corps of Engineers, Lower San Joaquin River and Tributaries Clearing and Snagging Project.	1987
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Report	Brown, L.R. and J.T. May		Macroinvertebrate Assemblages on Woody Debris and Their Relations with Environmental Variables in the Lower Sacramento and San Joaquin River Drainages, California	Environmental Monitoring and Assessment	In Press
Report	Yoshiama et all	RMY	Historical and Present Distribution of Chinook Salmon in the Central Valley drainage of California	Department of Wildlife, Fish and Conservation Biology UC Davis DFG, Inland Fisheries, Sacramento, Ca DFG Red Bluff, Ca	1995
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Survey	California Department of Fish and Game	DFG	Stream Survey Summary Data Sheets Cosumnes River Bioassessment	Water Pollution Control Laboratory	1995
Report	Pacific Gas and Electric		Kilarc-Cow Creek Project-606	Federal Power Commission	1976
Report	CALFED Bay-Delta Program		Joint CALFED/SJRMP San Joaquin River Fishery Technical Team Workshop Report	Sacramento, CA, CALFED Bay-Delta Program Ecosystem Roundtable, San Joaquin River Management Program	1997
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Report	California Department Fish and Game		San Joaquin River Chinook Salmon Enhancement Project Annual Report Fiscal Year 1991-1992	Fresno, CA, California Department of Fish and Game Region 4	1993
Survey	Stockton East Water District		List of latitudes and longitudes for barriers on Calaveras River, Mormon Slough, Mosher Creek, Potter Creek		2000
Report	Charles J. Brown, CDFG		An Inventory of Stream Habitat in Big Chico Creek	CDFG Bay-Delta and Special Water Projects Division,	1996
Report	California Department Water Resources		Dams within Jurisdiction of the State of California	DWR Bulletin 17-93	1993
Web site	USGS	USGS	Provisional Data, 11454000-- Putah C Nr Winters	http://s601dcascr.wr.usgs.gov/rt-cgi/gen_stn_pg?station=11454000	12/19/00
Report	USFWS, Sacramento, CA		Anadromous Fish Restoration Actions in Lower Mill Creek, Tehama County, California	Prepared for the Sacramento-San Joaquin Estuary Fishery Resource Office USFWS, Stockton, CA (1/2000)	2000
Report	California Department Water Resources		Comprehensive needs assessment for Chinook Salmon habitat improvement projects in the San Joaquin River Basin	San Joaquin District, Prepared for the California Department of Fish and Game: 93	1994
Web site	USGS	USGS	Provisional Data, 11453500-- Putah Cr Nr Guenoc	http://s601dcascr.wr.usgs.gov/rt-cgi/gen_stn_pg?station=11453500	12/19/00
Report	Technical Service Center, Denver, CO		Draft Conceptual Design Report: Battle Creek Salmon and Steelhead Restoration Project, California	Prepared for US Department of Interior and Bureau of Reclamation	2000
Report	California Department Water Resources		San Joaquin River Tributaries, Spawning Gravel Assessment, Stanislaus, Tuolumne, Merced Rivers	Red Bluff, CA, DWR Northern District	1994
Web site	USGS	USGS	Provisional Data, 11172945-- Alameda Creek Above Diversion Dam Near Sunol	http://s601dcascr.wr.usgs.gov/rt-cgi/gen_stn_pg?station=11172945	12/19/00

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Report	California Department of Water Resources		Clear Creek Fishery Study		1986
Report	California Department Water Resources		Merced River Robinson/Gallo Project - Ratzlaff Ranch.	Fresno, CA. San Joaquin District	1998
Web site	USGS	USGS	Provisional Data, 11173200-- Arroyo Hondo Near San Jose	http://s601dcascr.wr.usgs.gov/rt-cgi/gen_stn_pg?station=11173200	12/19/00
Report	North State Resources, Inc		Lower Clear Creek Floodway Rehabilitation Project, Shasta County, CA	USBR, BLM, and Western Shasta Resource Conservation District	1999
Report	California Department Water Resources		Comprehensive Needs Assessment for Chinook Salmon Habitat Improvement Projects in the San Joaquin River Basin	Fresno, CA. San Joaquin District: 93.	1994
Web site	USGS	USGS	Provisional Data, 11173510-- Alameda Creek Below Calaveras Creek Near Sunol	http://s601dcascr.wr.usgs.gov/rt-cgi/gen_stn_pg?station=11173510	12/19/00
Report (unpublished)	Azevedo, R.L., and Z.E. Parkhurst		The Upper Sacramento River Salmon and Steelhead Maintenance Program, 1949-1956	US Fish & Wildlife Service	1958
Report	Centers for Water and Wildland Resources		Tuolumne River Technical Advisory Committee Peer Review Forum for Methodologies of Measuring Salmon Smolt Survival, 1998 Lower Tuolumne River Annual Report.	University of California, Davis	1998
Web site	USGS	USGS	Provisional Data, 11173575-- Alameda Cr Blw Welch Cr Nr Sunol	http://s601dcascr.wr.usgs.gov/rt-cgi/gen_stn_pg?station=11173575	12/19/00
Report	Brown, Matthew R.		Benefits of Increased Minimum Instream Flows on Chinook Salmon and Steelhead in Clear Creek, Shasta County, California 1995-6	US Fish & Wildlife Service	1995
Report	Centers for Water and Wildland Resources		1998 Smolt Survival Peer Review Report, 1998 Lower Tuolumne River Annual Report	University of California, Davis	1999

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Web site	USGS	USGS	Provisional Data, 11176000-- Arroyo Mocho Nr Livermore	http://s601dcascr.wr.usgs.gov/rt-cgi/gen_stn_pg?station=11176000	12/19/00
Report	DWR and USBR		Effects of the Central Valley Project and State Water Project Operations from October 1998 through March 2000 on Steelhead and Spring-run Chinook Salmon		1999
Report	CH2M Hill		Central Valley Project Improvement Act Tributary Production Enhancement Report. Draft Report to Congress on the feasibility, cost, and desirability of implementing measures pursuant to subsections 3406(e)(3) and (e)(6) of the CVPIA	Sacramento, US Fish and Wildlife Service, Central Valley Fish and Wildlife Restoration Program Office	1998
Web site	USGS	USGS	Provisional Data, 11176500-- Arroyo Valle nr Livermore	http://s601dcascr.wr.usgs.gov/rt-cgi/gen_stn_pg?station=11176500	12/19/00
Report	Fry, D.H.		King salmon spawning stocks of the California Central Valley, 1940-1959	CDFG	1961
Report	Friends of the River.		Rivers reborn. Removing dams and restoring rivers in California.	November 1999. Sacramento, CA.	1999
Report	Friends of the River.		Rivers reborn. Removing dams and restoring rivers in California.	November 1999. Sacramento, CA.	1999
Report	California Department Fish and Game.		Steelhead restoration and management plan for California.	February 1996.	1996
Report	CH2M Hill		Hydrologic and Water Rights Analyses for Mokelumne, Calaveras, Stanislaus, Tuolumne, and Merced Rivers	Sacramento, CA 95833-2937, US Fish and Wildlife Service	1999
Web site	USGS	USGS	Provisional Data, 11177000-- Arroyo de la Laguna Nr Pleasanton	http://s601dcascr.wr.usgs.gov/rt-cgi/gen_stn_pg?station=11177000	12/19/00
Report	Airola, D.A, and Marcotte, B.D.		A Survey of Holding Pools For Spring-Run Chinook Salmon in Deer and Mill Creeks, 1985		1985

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Report	Demko, D. B. and S. P. Cramer		Outmigrant Trapping of Juvenile Salmonids in the Lower Stanislaus River, Caswell State Park Site, 1997.	Gresham, OR 97080, US Fish and Wildlife Service	1998
Web site	USGS	USGS	Provisional Data, 11179000-- Alameda C nr Niles	http://s601dcascr.wr.usgs.gov/rt-cgi/gen_stn_pg?station=11179000	12/19/00
Web site	Ward, Kevin		Watershed Project Inventory	http://endeavor.des.ucdavis.edu/wpi/	1997
Report	Demko, D. B., et al		Evaluation of Juvenile Chinook Behavior, Migration Rate and Location of Mortality in the Stanislaus River through the Use of Radio Tracking.	Gresham, OR 97080, Tri-dam Project	1998
Survey	Gray	F	York Creek, tributary to the Napa River, Napa County. Fish Population Sampling	DFG Region III office files, 7329 Silverado Trail Napa, Ca 94558	1986
Report	Pacific Gas & Electric Co.		Narrows Project (FERC 1403)	Application for new license for major project-existing dam.	1989
Report	Demko, D. B., et al		Outmigrant Trapping of Juvenile Salmonids in the Lower Stanislaus River, Caswell State Park Site, 1998	Gresham, OR 97080. US Fish and Wildlife Service, Anadromous Fish Restoration Program, Stockton CA	1999
letter	Richardson	D	York Creek Dam Project	Letter from Don in response to questionnaire from Glenda Marsh	2000
Report	CDFG		Lower Yuba River Fisheries Management Plan	Stream Evaluation Report No. 91-1	1991
Report	Demko, D.B. et al		Evaluation of Juvenile Chinook Migration Characteristics in the Stanislaus River, 1998 Annual Report.	Gresham, OR 97080. S.P. Cramer & Associates, Inc. for South San Joaquin and Oakdale Irrigation Districts	
Survey	Department of Fish and Game	DFG	Stream Survey, July 9,1973, York Creek	DFG Region III office files, 7329 Silverado Trail Napa, Ca 94558	1973
Report	CDFG		California Fish and Wildlife Plan, Volume 3, Part B	CDFG	1965

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Report	Domagalski	J.	Results of a prototype surface water network design for pesticides developed for the San Joaquin River Basin, California	Journal of Hydrology 192(1-4): 33-50	1997
Survey	Department of Fish and Game	DFG	Stream Survey. June 23, 1974, York Creek	DFG Region III office files, Yountville Ca	1974
Report	Hill, CH2M		Assessment of Big Chico Creek salmon and steelhead production		1993
Report	Dubrovsky, N. M., et al		Water Quality in the San Joaquin-Tulare Basins, California, 1992-95	Sacramento, CA, US Geological Survey: 38	1998
Survey	Department of Fish and Game	DFG	Stream Survey, August 5, 1975, York Creek	DFG Region III office files Yountville Ca	1975
Survey	Murphy, Hanson, Harris, and Schroyer		Central Valley Salmon and Steelhead Harvest Monitoring Project 1998 Angler Survey	CDFG	1999
Report	EA Engineering, Science, and Technology		Data Reports: Seining of Juvenile Chinook Salmon in the Tuolumne, San Joaquin, and Stanislaus Rivers, 1986-1989.	Lafayette, CA. For Turlock and Modesto Irrigation Districts	1990
Report	Department of Fish and Game	DFG	Department of Fish and Game stream Inventory Napa and Solano Counties	DFG Region III office files 7329 Silverado Trail Napa, Ca 94558	
Web site	Coleman National Fish Hatchery		Coleman National Fish Hatchery History/Background - Text From Coleman National Fish Hatchery	http://www.mp.usbr.gov/regional/battlecreek/CNFH.HTM	1999
Report	EA Engineering, Science, and Technology		1987 Juvenile Chinook Salmon Mark-Recapture Study	Lafayette, CA. For Turlock and Modesto Irrigation Districts	1990
Report			Barriers to Fish Migration in the San Francisquito Creek Watershed, Santa Clara and San Mateo Counties, California		2000
Report	Keir,W.M., and Ward, M.B.		Battle Creek Salmon and Steelhead Restoration Plan	Prepared for the Battle Creek Working Group	1999

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	EA Engineering, Science, and Technology		Juvenile Salmon Pilot Temperature Observation Experiments.	Lafayette, CA. For Turlock and Modesto Irrigation Districts	1990
Electronic Data File	Alexander	P	Synopsis of Alameda Creek Steelhead Restoration Efforts	10-11-2000	2000
Personal Comm.	Scott, John		Coleman National Fish Hatchery Biologist		
Report	California Department of Fish and Game.		Steelhead restoration and management plan for California.	February 1996	1996
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Report	US Fish and Wildlife Service.		Revised draft restoration plan for the Anadromous Fish Restoration Program. A plan to increase natural production of anadromous fish in the Central Valley of California.	May 20, 1997 Revised Draft	1997
Report	EA Engineering, Science, and Technology		Tuolumne River Salmon Spawning Surveys 1971-1988.	Lafayette CA. For Turlock and Modesto Irrigation Districts	1990
Web site			Central Valley Chinook Salmon Historic Stream Habitat Distribution		
	EA Engineering, Science, and Technology		Tuolumne River Summer Flow Study 1989 Report	Lafayette, CA. For Turlock and Modesto Irrigation Districts	1990
Report	Krovoza	J.F.K.	Designation of critical habitat for West Coast steelhead Federal Register 2/5/99 (Vol. 64. No. 24): to revise 50 CFR Part 226	Putah Creek Council document	1999
Personal Comm.	Boles, Jerry		Chief, Water Quality and Biology Section, DWR		

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	EA Engineering, Science, and Technology		Analysis of 1981 Lower Tuolumne River IFIM Data, 1992 FERC Report Appendix 5	Lafayette, CA 94549. For Turlock and Modesto Irrigation Districts	1991
Report	Shapovalov	L.S.	Report on Fisheries Resources in connection With the Proposed Yolo-Solano Development of the United States Bureau of Reclamation	In California Fish and Game volume 33 Number 2	1947
Report	Boles, Jerry		Water Quality and Aquatic Habitat Characterization in the Butte Creek Watershed	In Cooperation with Butte Creek Watershed Conservancy, and Sacramento River Watershed Program	2000
Report	EA Engineering, Science, and Technology		Aquatic Invertebrate Studies Report	Lafayette, CA 94549. For Turlock and Modesto Irrigation Districts	1991
Web site	National Marine Fisheries Service		Central Valley Chinook Salmon, Current Stream Habitat Distribution Table	http://swr.ucsd.edu/hcd/dist2.htm	2000
Report	EA Engineering, Science, and Technology		Data Reports: Seining of Juvenile Chinook Salmon in the Tuolumne, San Joaquin, and Stanislaus Rivers, 1986-1989, 1992 FERC Report Appendix 12	Lafayette, CA 94549. For Turlock and Modesto Irrigation Districts	1991
Web site	Marchetti & Moyle	MP & PB	The Putah-Cache Bioregion Project: Fish Sampling Progress report 1997-98	http://wdsroot.ucdavis.edu/clients/pcbr/what/fishmon.html accs.5/25/00	1998
Web site	National Marine Fisheries Service		Central Valley Chinook Salmon, Historic Stream Habitat Distribution Table	http://swr.ucsd.edu/hcd/cvshshd.htm	2000
Report	EA Engineering, Science, and Technology		Effects of Introduced Species of Fish in the San Joaquin River System, 1992 FERC Report Appendix 24.	Lafayette, CA 94549. For Turlock and Modesto Irrigation Districts	1991
Personal Comm.	Whitener	K.	Personal Communication with Keith Whitener of the Nature Conservancy via telephone on 6/7/00		
Report	USFWS, Sacramento		Draft Programmatic Environmental Assessment Anadromous Fish Restoration Actions in the Butte Creek Watershed	Prepared for USFWS, Sacramento-San Joaquin Estuary Fishery Resource Office	2000

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Report	EA Engineering, Science, and Technology		Effects of Turbidity on Bass Predation Efficiency, 1992 FERC Report Appendix 23	Lafayette, CA 94549, Turlock and Modesto Irrigation Districts	1991
Survey	Westgate	J	The Relationship Between Flow and Usable Salmon Spawning Gravel, Cosumnes River, 1956	Region 2, Inland Fisheries Department of Fish and Game	1958
Electronic Data File	CDFG		GrandTab	Red Bluff Office, Contact Colleen Harvey	2000
Report	EA Engineering, Science, and Technology		An Evaluation of the Effect of Gravel Ripping on Redd Distribution in the Lower Tuolumne River, 1992 FERC Report Appendix 11.	Lafayette, CA 94549, Turlock and Modesto Irrigation Districts.	1991
Survey	Harris	A	Survey of the Fish Populations of the Lower Cosumnes River		1996
Report	EA Engineering, Science, and Technology		Juvenile Salmon Pilot Temperature Observation Experiments, 1992 FERC Report Appendix 20	Lafayette, CA 94549, Turlock and Modesto Irrigation Districts	1991
Report	EA Engineering, Science, and Technology		Lower Tuolumne River 1990 Predation Study Interim Report.	Lafayette, CA 94549, Turlock and Modesto Irrigation Districts	1991
Personal Comm.	Kennedy	T	Personal communication with Trevor Kennedy	At 1020m 9h street.11/29/00	2000
Report	US Fish and Wildlife Service.		Revised draft restoration plan for the Anadromous Fish Restoration Program. A plan to increase natural production of anadromous fish in the Central Valley of California.	May 1997	1997
Report	US Fish and Wildlife Service.		Revised draft restoration plan for the Anadromous Fish Restoration Program. A plan to increase natural production of anadromous fish in the Central Valley of California.	May 1997	1997

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Report	California Department Fish and Game		Fish Screens and Fish Passage Project	December 1999	1999
Report	EA Engineering, Science, and Technology		Lower Tuolumne River Chinook Salmon Redd Excavation Report, 1992 FERC Report Appendix 7	Lafayette, CA 94549, Turlock and Modesto Irrigation Districts	1991
Report	Cox	B	Field Notes, Sonoma Marin, York Creek, Napa County	Department of Fish and Game Region 3	2000
Report	EA Engineering, Science, and Technology		Lower Tuolumne River Instream Temperature Model Documentation: Description and Calibration, 1992 FERC Report Appendix 18	Lafayette, CA 94549, Turlock and Modesto Irrigation Districts	1991
Letter	Torquemada	D	Letter to Bonnie Long, City Manager of St. Helena	MNFS Enforcement Office, Southwest region	2000
Report	EA Engineering, Science, and Technology		Lower Tuolumne River Spawning Gravel Studies Report, 1992 FERC Report Appendix 8	Lafayette, CA 94549, Turlock and Modesto Irrigation Districts	1991
Report	Department of Fish and Game		Fish Species List Napa County	Department of Fish and Game Region 3 files	
Report	EA Engineering, Science, and Technology		Possible Effects of High Water Temperature on Migrating Chinook Salmon (*Oncorhyncus tshawytscha*) Smolts in the San Joaquin River, 1992 FERC Report Appendix 21	Lafayette, CA 94549, Turlock and Modesto Irrigation Districts	1991
Personal Comm.	Whitener	K	Personal Communication with Keith Whitener via telephone 11/30/00		2000
Report	EA Engineering, Science, and Technology		Preliminary Juvenile Salmon Study: Report on Sampling of Chinook Salmon Fry and Smolts by Fyke Net and Seine in the Lower Tuolumne River 1973-1986, 1992 FERC Report Appendix 13	Lafayette, CA 94549, Turlock and Modesto Irrigation Districts	1991

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Report	California Department of Fish and Game		Fish Passage Inventory for York Creek	Department of Fish and Game Region 3 files	1974
Report	EA Engineering, Science, and Technology		Preliminary Tuolumne River Water Temperature Report, 1992 FERC Report Appendix 17	Lafayette, CA 94549, Turlock and Modesto Irrigation Districts	1991
Letter	Eming	J	Letter To Warden Jack Edwards Regarding York Creek Discharge	Department of Fish and Game Region 3 files	1992
Report	EA Engineering, Science, and Technology		San Joaquin River System Chinook Salmon Population Model Documentation	Lafayette, CA 94549, Turlock and Modesto Irrigation Districts	1991
Letter	Hunter	B	Letter to Mr. Marty Oldford Regarding the Removal of York Dam	Department of Fish and Game Region 3 files	1992
Report	EA Engineering, Science, and Technology		San Joaquin River System Chinook Salmon Population Model Documentation and Validation, 1992 FERC Report Appendix 1	Lafayette, CA 94549, Turlock and Modesto Irrigation Districts	1991
Survey	Leidy	R. A.	Distribution and Ecology of Stream Fishes in the San Francisco Bay Drainage	Hilgardia Volume 52 #8	1994
Report	EA Engineering, Science, and Technology		Spawning Gravel Cleaning Methodologies, 1992 FERC Report Appendix 9	Lafayette, CA 94549, Turlock and Modesto Irrigation Districts.	1991
Survey	Gray	F	Alameda Creek, Alameda County. Fish Population sampling	Department of Fish and Game Region 3 files	1988
Report	EA Engineering, Science, and Technology		Stock-Recruitment Analysis of the Population Dynamics of San Joaquin River System Chinook Salmon	Lafayette, CA 94549, Turlock and Modesto Irrigation Districts	1991
Survey	Department of Fish and Game		Stream Survey, Alameda Creek, 1957	Department of Fish and Game region 3 files	1957
Report	California Department of Fish and Game.		Fish Screens and Fish Passage Project.	December 1999	1999

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Report	California Department of Fish and Game.		Fish Screens and Fish Passage Project.	December 1999	1999
Electronic Data File	California Department Water Resources		Bulletin 17, Dams Within Jurisdiction of the State of California	Division of Safety of Dams	1999
Report	EA Engineering, Science, and Technology		Tuolumne River Fluctuation Flow Study Report, 1992 FERC Report Appendix 14	Lafayette, CA 94549, Turlock and Modesto Irrigation Districts	1991
Electronic Data File	Alameda Creek Alliance		The Alameda Creek Watershed	http://www.alamedacreek.com/alameda_creek_watershed.htm	2000
Report	EA Engineering, Science, and Technology		Tuolumne River Salmon Spawning Surveys 1971-1988, 1992 FERC Report Appendix 3	Lafayette, CA 94549, Turlock and Modesto Irrigation Districts	1991
Electronic Data File	Spliethoff	H	Wise Evidence Alameda Creek	http://wise.berkeley.edu/WISE/evidence/412.html	2000
	EA Engineering, Science, and Technology		Tuolumne River Summer Flow Invertebrate Study, 1992 FERC Report Appendix 28	Lafayette, CA 94549, Turlock and Modesto Irrigation Districts	1991
Study	East Bay Regional Park District		Initial Study / Mitigated Negative Declaration for the Alameda Creek Dam Removal and Restoration Project Sunol Regional Wilderness, Alameda County, California		2000
	EA Engineering, Science, and Technology		Tuolumne River Summer Flow Study Report 1988-1990, 1992 FERC Report Appendix 27.	Lafayette, CA 94549, Turlock and Modesto Irrigation Districts	1991
Notice	Person	V. H.	Memorandum, Notice of Application Filed	Department of Fish and Game region 3 files	1989
Report	EA Engineering, Science, and Technology		Export Mortality Fraction Submodel, 1992 FERC Report Appendix 26	Lafayette, CA, Turlock and Modesto Irrigation Districts	1992
Survey	Scoppettone	G	Alameda Creek, Alameda County: Fish Population Sampling, 8 May 1976	Department of Fish and Game region 3 files	1976

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Report	Murphy & Sidkom	K & N	Alameda Creek, Alameda County Stream Inventory Report	Department of Fish and Game Region 3 Files	1996
Report	EA Engineering, Science, and Technology		Lower Tuolumne River Spawning Gravel Availability and Superimposition, 1992 FERC Report Appendix 6	Lafayette, CA 94549, Turlock and Modesto Irrigation Districts	1992
Report	Aceituno & Nicola & Follett	M. E. & S. J. & W. I.	Occurrence of Native Fishes in Alameda and Coyote Creeks, California	Department of Fish and Game Region 3 files	Unk.
Report	EA Engineering, Science, and Technology		Stock-Recruitment Analysis of the Population Dynamics of San Joaquin River System Chinook Salmon, 1992 FERC Report Appendix 2	Lafayette, CA 94549, Turlock and Modesto Irrigation Districts	1992
Survey	Division of Fish and Game		Stream Survey, Arroyo Mocho	Department of Fish and Game Region 3 files	Unk.
Report	EA Engineering, Science, and Technology		Stock-Recruitment Analysis of the Population Dynamics of San Joaquin River System Chinook Salmon, 1992 FERC Report Appendix 2.	Lafayette, CA 94549, Turlock and Modesto Irrigation Districts	1992
Memorandum	Toffoli	E.V.	Catchable trout Stocking - Arroyo Mocho, Alameda County	Department of Fish and Game Region 3 Files	1978
Report	EA Engineering, Science, and Technology		Tuolumne River Fluctuation Flow Study Plan, 1992 FERC Report Appendix 15	Lafayette, CA 94549, Turlock and Modesto Irrigation Districts	1992
Survey	Scoppettone	G	Fish Population Sampling, Arroyo Mocho Creek, Alameda County	Department of Fish and Game Region 3 Files	1976
Electronic Data File	Department of Water Resources		Bulletin 17, Dams Within Jurisdiction of the State of California	Division of Safety of Dams.	1999

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Electronic Data File	California Department Fish and Game		Sport Fish Restoration Program Barriers Inventory	Provided by Paul Raquel	1999
Report	EA Engineering, Science, and Technology		Temperature and Salmon Habitat in the Lower Tuolumne River	Lafayette, CA, Turlock and Modesto Irrigation Districts	1993
Memorandu m	Strohschein	W.E.	Del Valle Reservoir	Department of Fish and Game region 3 files	1968
Report	EA Engineering, Science, and Technology		Gravel Cleaning Report: 1991-1993, FERC Report 96-10	Lafayette, CA 94549, Turlock and Modesto Irrigation Districts	1997
Survey	Alexander	P	Electroshock Sampling - Del Valle Reservoir, Alameda County, June 7, 1983	Department of Fish and Game region 3 files	1983
Report	EA Engineering, Science, and Technology		Intragravel Temperature Report: 1991, FERC Report 96-11.	Lafayette, CA 94549, Turlock and Modesto Irrigation Districts	1997
Memorandum	Wood	R	Del Valle and Contra Loma Reservoirs, Contra Costa County - Fishery Management Plans	Department of Fish and Game region 3 files	1968
Report	EA Engineering, Science, and Technology		Redd Superimposition Report, FERC Report 96-6, Supplement to 1992 FERC Report Appendix 6	Lafayette, CA 94549, Turlock and Modesto Irrigation Districts	1997
Survey	Smith	B.J.	Del Valle Reservoir, Alameda County - Results of Electrofishing on December 12, 1972	Department of Fish and Game region 3 files	1972
Report	EA Engineering, Science, and Technology		San Joaquin Basin Coded Wire Tagged Salmon Summary Report: 1978-1996, FERC Report 96-13	Lafayette, CA 94549, Turlock and Modesto Irrigation Districts	1997

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Report	EA Engineering, Science, and Technology		Tuolumne River GIS Database Report and Map.	Lafayette, CA 94549, Turlock and Modesto Irrigation Districts	1997
Survey	Anderson	K.R.	Del Valle Reservoir, Alameda County: Notes on Icthyofaunal Sampling, March 14, 1973	Department of Fish and Game Region 3 Files	1973
Report	EA Engineering, Science, and Technology		1987 Juvenile Chinook Salmon Mark-Recapture Survey, 1992 FERC Report Appendix 10	Lafayette, CA 94549, Turlock and Modesto Irrigation Districts.	1991
Survey	Anderson &Scoppettone	K.R. & G	Del Valle Reservoir, Alameda County; Fish Population Sampling 19 May 1976	Department of Fish and Game Region 3 Files	1976
Report	EA Engineering, Science, and Technology		Modeled Effects of La Grange Releases on Instream Temperatures in the Lower Tuolumne River, 1992 FERC Report Appendix 19	Lafayette, CA 94549, Turlock and Modesto Irrigation Districts	1991
Survey	Cogger & Paulsen	M & I.L.	Del Valle Reservoir, Alameda County; Fish Population Sampling, June 23, 1977	Department of Fish and Game Region 3 Files	1977
Report	EA Engineering, Science, and Technology		Don Pedro Project Fisheries Study Report, 1992 FERC Report	Lafayette, CA 94549, Prepared for Turlock and Modesto Irrigation Districts	1992
Report	Anderson	K.R.	Summary Statement of Significant Fisheries Activities at Arroyo del Valle Reservoir, Alameda County, in 1973	Department of Fish and Game, Region 3 Files	1974
Report	EA Engineering, Science, and Technology		Aquatic Invertebrate Report, FERC Report 96-9, Supplement to 1992 FERC Report Appendix 16	Lafayette, CA 94549, Turlock and Modesto Irrigation Districts	1997
Report	Fraser	J. C.	Summary of Significant Fish and Wildlife Activities at State Water Project Facilities During 1974	Department of Fish and Game, Region 3 File	1975

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Electronic Data File	California Department of Fish and Game		Sport Fish Restoration Program Barriers Inventory	Provided by Paul Raquel	1999
Electronic Data File	California Department of Fish and Game		Sport Fish Restoration Program Barriers Inventory	Provided by Paul Raquel	1999